THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

Vol. 65 Thursday, September 4, 1941 No. 1307

PUBLISHED WEEKLY

Subscription Terms (Home and Overseas): 21s. per annum. All Subscriptions are payable in advance.

THE FOUNDRY TRADE JOURNAL
49, Wellington Street, London, W.C.2.
WARTIME ADDRESS
to which all communications should be sent until further notice:—
3, Amersham Road, HIGH WYCOMBE, Bucks.
Telegraphic Address: "Zacatecas, High Wycombe."
Telephone: HIGH WYCOMBE 1792 (3 lines).

OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen
PRESIDENT: 1940-41
Major R. Miles, M.Eng., Head Wrightson & Company Limited, Thornaby-on-Tees.

LIST OF SECRETARIES—
General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester, 3. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: A.A. Timmins, F.I.C., 21-23, St. Paul's Square, Birmingham, 3.
East Midlands: S. A. Horton, "Three," Mostyn Avenue, Littleover, Derby.
Lancashire: A. Boyes, "Roseville," 7, Kirkstall Road, Davyhulme, Manchester.
London (pro tem.): V. C. Faulkner, 3, Amersham Road, High Wycombe, Bucks.
Middlesbrough (pro tem.): J. K. Smithson, North-Eastern Iron Refining Company, Limited, Stillington, Stockton-on-Tees.
Newcastle-upon-Tyne: C. Lashly, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Sheffield: W. Webb, B.Sc., 20, Brookfield Avenue, Swinton, Maxborough, Yorks.
Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Newport.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue Eccleshill, Bradford.
South Africa: F. C. Williams, Mutual Building, Corner of Harrison and Commissioner Streets, Johannesburg.

Bristol: A. Hares, 167, Ridgeway Road, Fishponds, Bristol.
Burnley: H. Buckley, Ellsmere, Norfolk Avenue, Burnley, Lancs.
East Anglian: J. L. Francis, 12, Glenhurst Avenue, Colchester Road, Ipswich.
Falkirk: T. R. Goodwin, "Viewfield," Falkirk Road, Bonnybridge, Scotland.
Lincoln: E. R. Walter, M.Sc., The Technical College, Lincoln.

The Institute of Vitreous Enamellers
President: Professor J. H. Andrew, D.Sc., Department of Applied Science, The University, St. George's Square, Sheffield.
Chairman: W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary: Dr. G. T. O. Martin, 21-23, St. Paul's Square, Birmingham, 3.

Foundry Trades' Equipment and Supplies Association
President: G. E. France, August's, Limited, Thorn Tree Works, Halifax.
Acting Secretary: Miss L. Cox, 52, Surbiton Hill Park, Surbiton, Surrey.

Welsh Engineers' and Founders' Association
President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION
The Registered Office and Laboratories of the B.C.I.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone; Colmore 4274-4275 Telegrams: CIRA
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

Contents

	PAGE
Expanding Good Work	151
Technical Bulletins on Vitreous Enamelling	152
Institute of Metals	152
Painting Magnesium Alloys	152
Random Shots	152
British National Specifications for Cast Iron	153
Publications Received	154
Small Diameter Cupola Practice	155
Salvaging Porous Castings	157
Output of the War Factories	157
Reports on Special-Duty Cast Irons	158
Vitreous Enamelling Section—The Acid Resistance of Finished Enamelware	160
The Week's News in Brief	164
Trade Talk	164
Personal	164
Obituary	164
New Companies	164
Reports and Dividends	164
Contracts Open	164
Control of Iron and Steel	164
Raw Material Markets	166
Patent Specifications Accepted	166

Expanding Good Work

If a group of foundries concentrates its sand research in one particular location, achieves eminently satisfactory results and desires (*a*) to emulate this practice in the associated works, or (*b*) to impose buying specifications, then, under the present state of the art, this cannot be satisfactorily accomplished. This is due to the established fact that the figures obtained in one moulding shop are not reproducible in others. This temporarily at least puts an end to the controversy as to whether one should standardise upon this or that type testing equipment, whilst in no way detracting from the established fact that any of the approved types of apparatus—consistently and intelligently applied—will control to advantage the proper functioning of a basic factor in the economic production of castings. Both Mr. T. R. Walker and Mr. W. Y. Buchanan have been insisting for a long time that research of a much more fundamental character than hitherto is essential before sand testing is placed on a scientific basis, and now their pleas are being re-echoed by some of the leading technologists in America. For instance, the A.F.A. Committee on Sand Research, as a preliminary to investigating the refractory properties of sand, undertook room temperature experiments to ascertain the standardised properties of sands as given by two sizes of test-pieces. One of these measured 2 in. by 2 in., rammed by the Standard A.F.A. method, and the other 1¼ in. by 2 in., rammed with the Dietert rammer. "Considerably different" properties were shown. The narrower specimens have consistently greater green apparent densities; lower permeability numbers; higher green and dry strengths and lower deformation values. The magnitude of these differences varies with the type of sand being tested, and its moisture content; and there is apparently no formula available for the conversion of the results yielded by the one into those to be expected from the other. Long before we had any interest in the properties of sand from to-day's angles, we remember seeing at an exhibition of scientific novelties a gadget which may throw some light on a neglected property of sand. If our memory serves us correctly, the gadget consisted of a tube, the bottom of which was closed by the adherence of a sheet of tissue paper. The tube was half filled with sand; and riding upon it was a plunger surmounted by a short vertical bar carrying at right angles a centrally disposed beam. At both ends of the beam were depending handles, and the public was invited "to test the strength of the tissue paper" by applying their full weight to the strap-handles. It was explained by the scientist in charge that sand does not transmit applied force in the line of application, but diffuses it in other directions, mainly at right angles. We confess that we may have, through the passage of time, missed the main point of the argument, but the repetition of such an experiment, accompanied by some measuring devices, might disclose information of a fundamental character relative to the dispersal of forces consequent upon the ramming of sand. It appears to us that the arbitrary methods now standardised upon for the ramming of test-pieces need to have a more scientific basis, if results are to be obtained which are reproducible in the foundry laboratories throughout the world. This is hinted at in the latest report of A.F.A., referred to above, for it says of the two types of test-pieces used in their research at room temperatures that closer agreement might be had by "changing certain conditions of ramming." An interesting phrase is that "it is not probable that the two sizes of specimens can be made, by any method of drop-ramming, to agree in all room temperature test properties."

To emphasise the real necessity for fundamental research on this very important subject, we could not do better than quote the final paragraph of the Report cited: "It is difficult to state with any degree of definiteness whether the 1¼-in. by 2-in. or the 2-in. by 2-in. specimen is the better for sand testing, whether at high or room temperatures. It may be that both sizes of specimens have their own individual applications."

Unquestionably excellent work has been accomplished in the field of foundry sand research; it has materially contributed to the economic stability of the industry, yet to extend its usefulness to the improvement in many of its properties, a new start must be made, built not upon standardised empiricisms, but on fundamental scientific facts.

Technical Bulletins on Vitreous Enamelling

The technical staff of the Ferro-Enamel Corporation, Cleveland, Ohio, has by the issue of six bulletins materially enriched the technical literature of vitreous enamel. Bulletin No. 1 carries the not-too-well-chosen title of "Heat Transfer of Various Metals and other Materials," by J. C. Bell. This, to the reviewer's mind, would be improved by changing it to "Heat Transfer of Coated and Uncoated Metallic Sheets and Utensils made therefrom." By so changing the title a real indication of the contents is given. The data disclosed are not of a fundamental character, but are of a utilitarian character, as they enable the manufacturer of vitreous enamel hardware to compare the heat-transference potentialities of his goods and designs with those made in competitive materials and forms. The second bulletin, by B. J. Gweo and Mr. J. Bahnsen covers an investigation into the stabilisation of the reflectance and colour of recoat enamels. Its object was to provide a means whereby a recoat enamel could be prepared which would retain a predetermined shade of colour, essentially white, and degree of reflectance regardless of the number of coatings after the first enamel coating has been applied. These two authors are responsible for the next bulletin, which deals with errors in reflectance measurements of vitreous enamel surfaces. By using the data disclosed commercial measurements should be of the order of + or − 0.5 per cent. instead of the normal 2 per cent.

Bulletin No. 4, prepared by M. J. Bozsin, details a very large number of efficiency tests carried out on four distinct types of enamelling muffles. Low water content of the order of 1.34 per cent., associated with a low (0.10) CO value, is stated to be a good criterion for judging the efficiency of furnace atmospheres. The last, No. 6, and the penultimate bulletins are both devoted to the hairlining defect. Mr. Gweo, who is responsible for the latter, devised a test method which produces hairlining in the laboratory. The final bulletin, prepared by E. E. Bryant, takes the question a stage farther, by studying some of the physical properties of sheet steel enamels as affecting hairlining. However, insufficient data have been accumulated to postulate the imposition of any definite limits.

Altogether, the bulletins comprise an excellent series. Moreover, they are available, so long as stocks last, to our readers on writing to Ferro-Enamels, Limited, Ounsdale, Wimborne, Wolverhampton.

Institute of Metals

The Thirty-Third Annual Autumn Meeting of the Institute of Metals will be held on September 17 at the offices of the Institute, 4, Grosvenor Gardens, London, S.W.1. After the conclusion of some formal business, the following Papers will be presented:—

"Causes of Porosity in Tin Bronze Castings," by Mr. T. F. Pearson and Mr. W. A. Baker.

"Unsoundness in Gravity Die Cast Silicon-Aluminium Castings," by Dr. R. T. Parker.

"The Influence of Crystal Structure on the Cold Rolling and Annealing of Copper Strip," by Dr. Maurice Cook and Mr. T. Ll. Richards.

"X-ray Examination of the Crystal Structure of Rolled Magnesium and a Magnesium Alloy," by Mr. D. E. Thomas.

Cupola v. Electric Furnace

According to R. COMINA, in "Industria Meccanica," cast-iron turnings can be melted with better advantage in an electrode electric furnace than in the cupola.

Painting Magnesium Alloys

Mr. Robert T. Wray, writing in "Industrial and Engineering Chemistry," details a number of tests he has carried out on the protection of the surfaces of plates made in various types of magnesium alloys. From these tests he has drawn the following conclusions:—

The accelerated exposure test, comprising cycles of immersion in synthetic sea water combined with atmospheric exposure at an angle of 45 deg. to the vertical facing south, has been found a reliable means of quickly obtaining a measure of the relative durability of various protective coatings on magnesium alloys. Any particular painting system will appear to give the best protection on the alloys which are most resistant to corrosion. Resistance to corrosion is largely determined by alloy composition.

A satisfactory surface treatment is important. Of the various treatments tested, the chrome pickle followed by dichromate sealing and the HF-dichromate coating proved to be about the most effective both from the standpoint of protection and as bases for paint coatings.

The selection of the proper priming coat is also important. Zinc chromate primers made with phenolic resin varnishes of short to moderate oil length were found to be most effective, although primers of the well known P27b zinc chromate type gave good results.

EDITORIAL INDEX TO VOL. 64

The Editorial Index to Volume 64 of the Journal, January to June, 1941, is now available. Readers who wish to receive a copy should make application to the Publisher, 3, Amersham Road, High Wycombe, Bucks.

Aluminium pigmented finishing coats gave the best protection; the most suitable vehicles were the phenolic resin vehicles of moderate oil length. Finishes of this type, in which both primer and top coat were made with the moderate-oil-length phenolic resin varnish, have shown little failure on the more corrosion-resistant alloys after 26-week exposure in the alternate immersion test.

The order of failure of various coatings in the alternate immersion test agrees very well with that obtained in tests at the sea coast, although failure occurs much more slowly in the latter environment. With the best finishing systems, satisfactory protection has been obtained on the more corrosion-resistant alloys for periods up to 3 or 4 years in tests at the sea coast. In industrial-atmosphere tests even longer periods of protection have been secured; in the latter case some of the experiments have been under exposure for 5 or 6 years without showing noticeable signs of failure.

The tests have shown that it is possible, by proper selection of alloys and painting systems, to obtain durable protection on magnesium alloys comparable to that secured on some of the other light metals.

Viscosity of Magnitogorsk Blast-Furnace Slags

In studying the viscosity of the running slag at the Magnitogorsk blast furnaces, M. OSSTROUCHOW, in "Stal," reports that a special viscometer had to be designed for this purpose, as it was found impossible to measure the viscosity of Mn slags in graphite crucibles at 1,400 and 1,450 deg. From the measurements made, it is concluded that the fluidity and crystallisability of silica-alumina-lime slags can be raised by adding magnesia or iron oxide. If both are added, the slag becomes more fluid and the crystallisation temperature is diminished by about 100 deg. The formation of a crust on the slag interferes with viscosity measurement.

Random Shots

The Uncontrollability of Nature!

Two friends were discussing the triumphs and failures of their food-producing efforts. One had cleaned out the parrot cage and scattered the seed amongst the rubble on top of the air-raid shelter, for the sparrows. Imagine his surprise when later in the year there sprung up a fine crop of sunflowers and marrows sufficient to keep both family and parrot going for many a week.

* * *

The other man was not so lucky. Being inordinately fond of mushrooms, he decided to grow his own. So with loving care he prepared in the cellar an orange box filled with the finest loam and manure. There sprung up a multitudinous crowd of ridiculous looking toadstools which grew to unheard of heights. Thoroughly disgusted, he threw the whole box of tricks on to the rubbish dump at the bottom of the garden. The following autumn, on returning from a holiday, he was greeted by the gardener with—"Oh, Sir, whilst you were away there was a lovely crop of mushrooms at the end of the garden. I could hardly keep them till you came home, so I took them in for the missus to cook. They were delicious."

* * *

"And how do you propose to make the world a better place to live in after the war?" asked the vicar of one of his parishioners.

"I am going to form a committee for the reform of the drink laws," answered the village "Caution."

"Ah! that is a very noble work. What measures do you propose to introduce?" asked the vicar, brightly.

"I intend to get a law passed sanctioning the sale of three-quarters of a pint with meals. Half a pint's hardly enough to wash down a decent steak with, and a pint's just a little too much."

* * *

Optimists!

Almost in the same breath that the Government decrees that the consumption of milk shall be drastically reduced, it proposes to issue extra clothing coupons for growing girls and boys.

* * *

A young refugee's ideas on the English public school system were recently summed up in the following complaint: "During the whole of that blazing hot weather we had to play two hours a day compulsory tennis in trousers of a very particular shade of grey!"

* * *

A Cockney youngster was doing his homework and, for the benefit of the whole family, he read the following passage from his geography textbook: "And when the winter snows melt, the mountain streams become rushing torrents of crystal clear water."

"Crystal clear, my eye!" interrupted his small brother in scornful tones. "Why everyone knows that snow is black when it melts."

* * *

To the already long list of names of firms which make singularly appropriate or amusingly unappropriate combinations can be added that of Messrs. Glydon & Guess, expert watch makers.

* * *

Apology Impending?

. . . Surviving this terrible ordeal (as a member of the crew of a boat which was sunk in 1939), we regret to say that he has again been torpedoed and is amongst the very few survivors which have been picked up at Trinidad.

—"Refractories Journal."

* * *

The best crossword clue of the week comes from "The Times."

Clue: What makes maids err?

Answer: Admirers.

British National Specifications for Cast Iron

DISCUSSION AT MANCHESTER CONFERENCE OF Mr. J. G. PEARCE'S PAPER*

In the course of the proceedings of Session "B," presided over by Mr. V. C. Faulkner, past-president, at the recent Manchester Conference of the Institute of British Foundrymen, Mr. J. G. Pearce's Paper on "British National Specifications for Cast Iron" was presented for discussion.

The CHAIRMAN (Mr. V. C. Faulkner) remarked that this was an ideal Paper from a director of research for an industry, because it was what might be termed a liaison Paper in so far as it formed a logical link between the consumer and the manufacturer. It was also very important from the national point of view, because all industrial nations were giving attention to this particular subject. It was pleasing to record that Mr. Pearce's efforts in this particular field were both well recognised and appreciated all over the world, and his work was materially reinforcing the already high opinion of British research activity held in American metallurgical circles of various aspects of testing.

MR. HUDSON remarked that, due to his lessened contacts with the cast iron industry, he was not qualified to make any serious contribution to the discussion, but he would like to say that, as foundrymen, they all appreciated the work done on the question of specifications. One felt that the non-ferrous foundrymen could take a lesson from it, particularly in reference to the list of "revolutionary features," with special emphasis on item 4. "The adoption of test-bars cast separately from the casting."

A Standard Test Mould

MR. E. LONGDEN (Manchester) observed that one result of the publication of the Paper in THE FOUNDRY TRADE JOURNAL would be that the foundrymen in the remote parts of the country who did not come in contact with specifications would be made acquainted with the fact that they did exist, and from that point of view good work would have been accomplished. On the question of the method of casting test-bars, he would ask, when would they have some definite recommendation of a standardised mould into which to cast these bars?

Stress Relieving Necessary

MR. A. PHILLIPS (Manchester) said it had to be recognised that a great advance had been made in the test-bar demands when one turned back to Specification 321, and remembered that they had got to Grade 4 in the 786 Specification. That gave some idea of the great strides that had been made.

He would like to have Mr. Pearce's opinion on the question of stress relief with these high-duty cast irons. Engineers called them "Grade 3 cast irons." One found that the castings were a little more difficult to produce in the foundry than the ordinary cast irons. When put under pressure tests, certain parts showed failures which, in his opinion, were due to the absence of a stabilising heat-treatment or suitable normalising process. The Cast Iron Research Committee, or the I.B.F. Technical Committee, would do a good work for the industry if they would indicate what, in their opinion, was the most difficult box-shaped casting to make; this to be subjected to different types of pressure tests and different stress-relieving treatments. From the information obtained, the industry would be able to obtain a guide as to the most suitable treatment to be applied. He was afraid these castings in the high duty alloys may get a bad name with some engineers, and a great service would be done if they could either show or give a lead as to whether it was necessary to have a normalising treatment or a change in the mixture of the metal.

It had been suggested that Grade 4 would replace steel castings and the majority of engineers wrongly held the opinion that Grade 4 possessed a modicum of elongation. They included castings in that particular grade on these grounds and they welcomed it because it would be an advantage to have cast iron which had a little elongation. He did not know whether Mr. Pearce had anything up his sleeve which he was going to give them in the near future but if he had it was to be hoped he would do it soon because it would be very much appreciated.

Another point in connection with the high-duty cast irons was that engineers were not sufficiently enlightened in regard to the sections these cast irons could be used in. They had the advantage of the various sizes of bars which were introduced in the 321 Specification, but if the sections on which the various grades of cast iron were based were more stressed to engineers it would assist the foundry considerably.

The CHAIRMAN pointed out that elongation could be imparted to cast iron by malleabilising, which simple factor often seemed to have been forgotten, and annealing processes were of short duration. People who were manufacturing Grade 4 high-duty irons were buying stress relief furnaces at the present time. Actually the French Admiralty specifications demanded such stress relieving treatment.

More Specifications Needed

MR. YATES, dealing with the general question of specifications, said it had been his experience that co-operation between the designers and the foundrymen themselves, a feature which everybody desired to see, had been rather vague; in fact, it was often impossible to get co-operation wholly between the designer on the one hand and the man who tried to make the material on the other, especially with respect to non-ferrous castings. If a more elaborate range of specifications could be obtained, it would enable the designer to judge his materials more accurately and specify them to the producing foundry. It was possible that the foundry might be faced with the problem of making castings sub-contracted; they would be asked to make a casting to withstand certain tests, although often enough it was not known precisely what the casting had to do. A more elaborate series of specifications, whether from the cast-iron, or non-ferrous point of view, was to be desired mainly to assist not only the designer in getting all he wanted but to assist the foundry in giving to the designer all he needed.

Practical Applicability

DR. EVEREST said they were under a debt of gratitude to Mr. Pearce for an excellent Paper which provided a great deal to think about. Many of the points raised in connection with the position of specifications would be very useful when the question of revision came up after the war. He was particularly interested in Fig. 2 and in the author's method of working out what was suggested as a "Figure of Merit." That rather tied up with the work already done by Hurst and others, but Mr. Pearce had gone a stage further in basing his figure on the true elastic part of the stress-strain curve. He (Dr. Everest) was inclined to think that as a practical works test that was not very suitable, certainly for specification purposes, because it obviously involved fairly accurate drawing of the curve. Although it might be excellent from a research point of view, it would not be of very much practical help, and on that aspect of the matter he would like Mr. Pearce's view.

In regard to the grading of strength in relation to the size of the test-bar the whole question was still very fluid, and much thought had been devoted to considering whether they should adopt the American idea of not mentioning the size of the test-bar but simply asking for iron of a certain strength, and then assuming that strength would appear in the test-bar representing the section of the casting. That was the most logical way to get out a specification. Mr. Pearce advanced many arguments in favour of the British practice, but on the other hand it could be said that the present grading of strength in relation to test-bar size in specifications was really a compromise. An iron which was suitable for a large bar was obviously quite unsuited for a smaller bar, and the figures showing rising strength with decreasing size of the bar bore very little relationship to actual practice. When the question of revision came up it might be considered whether we should not follow the lines of the American specification.

Mr. Pearce had done a very good piece of work in drawing the curve (Fig. 3) from a very large number of results available, but he would suggest that emphasis should be given to the fact that that curve referred only to pearlitic irons. There were other structures to which the curve would not apply at all.

MR. P. A. RUSSELL wrote the following contribution, saying he had been very interested to read this Paper, and regretted his inability to be present to take part in the discussion. Mr. Pearce had been more successful than the writer has ever been in obtaining a curve (Fig. 3) of the relationship between tensile and transverse strengths of cast irons, and personal experience was that enormous variations occurred. He did not believe that there was a constant relationship in view of the wide varieties of irons available. At a transverse rupture stress of 30 tons per sq. in. the variations in tensile will range between 15 and 22 tons per sq. in. The general tendency is for the rigid hard irons to give low transverse strengths and deflections, and the tougher but softer types of high duty cast iron to give high transverse strengths.

The writer had never appreciated the importance attached to the transverse test, and its main virtue seems to be that it is cheaper to carry out than a tensile test. It is fairly reliable for routine works control of standard mixtures, but very difficult to relate the results obtained over a variety of irons.

He agreed that it will probably be desirable, after the war to abolish the present 321 and 786 specifications, and substitute one specification approximately as given in Table III of Mr. Pearce's Paper. He did not, however, think it necessary to go to quite such small steps as 2 tons.

With regard to the size of bar, he was in agreement with the reduction of requirements on the larger bars, and believed that the British specification had gone rather too far in this respect and that the differences should be reduced.

Finally, he wished to make it clear that these views were personal, and did not necessarily represent the views of the Cast Iron Sub-Committee of the Institute's Technical Committee.

*Foundry Trade Journal, July 24, 1941, pp. 59-60 and 64.

British Cast-Iron Specifications

Author's Reply

MR. PEARCE, replying to the discussion, agreed with Mr. Hudson that it was very useful to match experience in the non-ferrous and cast iron fields, and he would like to include the cast steel field as well. He was sure there was a great deal to be learned from each other, and in that way each branch could improve its own particular practice.

There was some force in Mr. Longden's point about the casting of bars. The 321 Specification gained the confidence of the user engineer by specifying that the bar should be cast in the same type of mould as the casting itself, the idea being that, as far as possible, the two metals should be treated on absolutely identical terms. It was the same with the thermal treatment. If one was thermally treated, the other must be dealt with on exactly the same line. He agreed it was a good thing from the point of view of test-bars to standardise the conditions and to pour into a dry-sand mould. For some years past the Research Association made all the standard test-bars for research purposes in baked core sand, and without doubt the results were superior to those obtained with green sand.

Mr. Phillips's point about stress-relief annealing was a very interesting one. Many new components were being made in cast iron, particularly since war broke out. It was the practice previously to soften cast iron for machining purposes by annealing it, but it had the effect of materially reducing the ordinary tensile and transverse strength. An iron that had passed a specification before annealing would not necessarily pass it afterwards. Annealing used to be carried out from above what was known as the critical point, and the temperatures for softening had tended to come down. Conversely through the work of people like Machin and Oldham, Benson and Allison, and from the records of the Proceedings of the Institute and work from America and elsewhere, it would appear that the tendency had been for temperature of stress relief to rise, and there was a certain amount of confusion between the two. If the stress-relief temperature were too high, it tended to bring about the structural change which took place during a deliberate attempt to soften, and therefore there was a risk of getting a lower tensile strength. Ordinary cast iron shrunk on cooling, and, if there were two sections, a thin section adjacent to a thick section, the former cooled more quickly and had gone further at any given moment of cooling towards its final shrinkage than the thicker section. The result was a pull or stress between the two. That, on occasion, might reach such a value that it exceeded the strength of the material at the particular temperature, and the casting broke in the mould. In these high-duty irons a lower carbon content meant that the shrinkage was higher. In common cast iron the natural shrinkage was offset and diminished by the expansion that took place as the graphite was deposited. In higher duty iron the over-all shrinkage was increased so that, as the iron became more and more high-duty iron, stress-relief annealing was necessary.

He would suggest for that a temperature not exceeding 550 deg. C., because above that figure there was a tendency to get a softening—a change of structure from pearlite to ferrite. There might be a tendency to get a slight amount of growth, and it was more important to cool slowly than anything else.

He entirely agreed with the points raised by Mr. Yates, subject to this proviso. If they increased the number of specifications, which he thought did help the designer, they must accompany them by test and control, to be quite sure the specification values were reached, otherwise the designers' work rested on a false foundation.

Dr. Everest had suggested that Fig. 2 could not be used as a routine test. He agreed, and as an alternative test one might take the transverse rupture stress, with the total deflection as an indication. That was subject to some degree of error.

He was grateful to Dr. Everest for pointing out that Fig. 3 was based on pearlitic irons. It was the presumption from the start of the Paper that it applied to B.S.I. specifications 321 and 786 which were predominantly pearlitic, but it was important to state, and he took this opportunity of pointing it out, that it did not apply to austenitic and martensitic or chilled irons.

He did not agree with Mr. Russell's observations about the variations between tensile and transverse strengths. They usually arose from faulty material or faulty testing in one way or another. If they got sound material and tested it properly there was a reasonable concordance between tensile and transverse strengths and in rigid hard irons a low transverse was accompanied by a low tensile and conversely.

Vote of Thanks

MR. F. J. COOK (past-president), proposing a vote of thanks to Mr. Hudson* and Mr. Pearce, remarked that the Papers were both interesting and valuable to the industry. With regard to national specifications, sooner or later when the war was over that matter would have to be tackled in a deeper sense than had been the case in the past. There had always been a certain amount of laxity in the testing of metals and Mr. Pearce's contribution would go a long way towards promoting the introduction of proper specifications in the future.

MR. A. L. KEY (Manchester) seconded. He thought great credit was due to both the authors for the cases they had made in support of their respective theories.

The CHAIRMAN observed that normally they were indebted to those who prepared Papers, but in wartime, with the pressure of business, greater thanks were due to those who gave up their leisure for work in the common cause.

The vote of thanks was carried with acclamation.

Asphalt Protection against Incendiaries

One of the special bituminous products made by Wailes Dove Bitumastic, Limited, and supplied to the Admiralty, the British Mercantile Marine, and to foreign mercantile fleets, is a special deck covering in place of wooden planking. With certain minor modifications in manufacture, it has been found that a special deck covering used in place of wooden planking is an effective safeguard against incendiary bombs. This was demonstrated recently when an incendiary bomb was placed in the centre of a wooden flooring covered with a 1-in. layer of "Bitumastic" flooring mastic. The bomb was ignited and burned furiously; but when it had burned itself out, the damage to the mastic was found to be less than ½ in. deep, while the boards beneath were quite cool.

Shot Blasting and Fatigue

At the recent Chicago meeting of the A.S.T.M., W. M. MURRAY and J. M. LESSELLS submitted a Paper on the effect of shot blasting and its bearing on fatigue. In order to prevent the formation of fatigue cracks and the eventual breakdown of structural parts under the action of repeated stressing, means have been employed for producing better surface finish and for artificially raising the endurance limit. The authors present an analysis of the effects due to shot blasting and its influence upon steels in different conditions. In some cases shot blasting can be very advantageous, but this depends upon the use to which the material is to be subjected as well as its condition. Test results are given to confirm the analysis and to illustrate the relative advantages due to this type of surface finish.

* For the discussion on Mr. Hudson's paper, "Moulding Steam Valve Lids," see Foundry Trade Journal for August 14, 1941.

Publications Received

Memorandum on Jigs and Manipulators for Fusion Welding. Published by the Advisory Service on Welding, Ministry of Supply, Directorate of Scientific Research, Great Westminster House, Horseferry Road, London, S.W.1.

In this 28-page pamphlet, most of the space is devoted to illustrations, it being deemed, and the reviewer wholeheartedly endorses the notion, that such a method better explains the underlying principles of jib assemblies than does much letterpress. The importance of the subject is well illustrated, by the case of a machine frame, wherein the use of a manipulator reduced welding time by 32 per cent.

Memorandum on Specifying Welds on Drawings and the Control of Arc Welding Procedure. Published by the Advisory Service on Welding, Ministry of Supply, Directorate of Scientific Research, Great Westminster House, Horseferry Road, London, S.W.1.

This very useful 10-page pamphlet has well accomplished three objectives. It has defined the essential information to be carried on blue prints; it has postulated a series of standardised symbols for indicating welds on drawings, and has detailed a method of controlling procedure to ensure that the mechanical properties of the welded joints assumed in the design are reproduced in the finished job.

Reports on Special-Duty Cast Irons

(*Concluded from page* 158.)

having a Firth diamond hardness of about 850. The material normally used for the lining of the mill was manganese steel, and the mill was operated at a constant speed and a uniform rate of feed. The Ni-hard martensitic liner gave a life of 1,500 hours, compared with 970 hours life of a manganese steel lining. In a ball mill used in Canada for crushing a siliceous material, the loss in weight, in milligrams per sq. cm. for each ball, of Ni-hard balls per run was 46, compared with 36 for Stellite, these being better than any of the forty or more materials tested.

Physical Properties

Thermal Expansion.—A cast iron with the following percentage composition:—T.C. 2.95; Si, 0.80; Ni, 4.86; Cr, 1.55; Mn, 0.40; gave the values shown in Table III.

TABLE III.—*Mean Coefficient of Expansion in Millionths per Deg. C. from* 10 *Deg. C. to Indicated Temperature*

93.	205.	205.	260.	316.	371.	426.
7.78	8.69	9.83	10.73	11.32	11.92	12.37

The mean coefficient of thermal expansion of this iron is 10.38 millionths per deg. C. For further details, the Paper by T. J. Wood (1935) should be consulted.

Magnetic Properties.—Martensitic irons are magnetic, but this property decreases with an increasing amount of austenite in the structure.

REFERENCES.

Delbart, G., and Lecoeuvre, E. 1934 (July) Bulletin de l'Association Technique de Fonderie, p. 279. "An Investigation of the Properties of Austenitic Iron Containing Nickel and Manganese."

Ellis, O. W. 1936-7 Proc. Inst. British Foundrymen, vol. 30, p. 137 (text) and p. 160 (discussion), "Wear Tests on Ferrous Alloys."

Hallett, M., and Everest, A. B. 1938-9 Proc. Inst. British Foundrymen, vol. 32, p. 115 (text) and p. 122 (discussion), "Specially Hard Alloy Cast Iron for Resistance to Abrasion."

Hurst, J. E. 1939a Metallurgia, vol. 20, p. 1, "Experiments with Nickel-chromium Wear-resisting Cast Iron Alloys. See also Proc. Staffordshire Iron and Steel Inst., 1938-9, vol. 54, p. 76 (text) and p. 86 (discussion). 1939b FOUNDRY TRADE JOURNAL, vol. 60, p. 323, "Wear-resisting Alloys. Uses for Nickel-chrome Cast Irons."

Mond Nickel Company. 1936 Publication B.21, "Ni-Hard. High-hardness White or Chilled Nickel-alloy Cast Irons." 1938 Publication B.22, "Ni-Hard Rolls in Strip Mill Service." 1938 Publication B.23, "Ni-Hard Rolls."

Wood, T. J. 1935 Trans. Am. Soc. for Metals, vol. 23, p. 455, "Thermal Expansion Characteristics of Some Nickel Cast Irons."

Small Diameter Cupola Practice*

By WILLIAM POLA

(*Slightly Abridged*)

(*Continued from page* 146.)

Control of Blast

By using a fan with a greater output than is necessary for normal running, a wide range of melting rates can be used. Control is obtained by a butterfly valve fitted in the wind pipe. The valve is fitted with a pointer, set in line with the butterfly itself, and fixed to the same shaft. Behind the pointer is a dial which is calibrated. Having found the best setting of the valve for starting the heat, it can be repeated from day to day. Small variations are noted on the pressure and volume gauges, and adjusted with the valve. On days when the humidity is about 30 to 40 per cent., the barometer around about 30, and the temperature from 60 to 70 deg., the air blast appears to give best melting. Pressure gauge reading high, showing undue resistance to the air, usually indicates packed charges of coke and iron. Coke and scrap may be smaller than usual. Where high pressure is caused by packed charges and the blast is produced by a fan which is not positive, a falling off of volume may be noted. The greater the resistance to the fan the less load there is on it. By opening the valve wider than is used under normal conditions, the reserve of air is brought into use, and the usual melting rate maintained. When using a positive blower, the air can be spilt at the blow-off valve in the pipe line.

Towards the end of the heat as the charges fall away from the charging door, less resistance, caused by the emptying stack, will give a higher volume reading. Should the tuyeres be very dirty near the end of a long heat, high pressure and low volume may be noted. By using the butterfly valve, adjustments are easily made. Mild blast that will maintain a suitable melting rate is preferred to a high, fierce one, which may reduce the bed height; fierce blast combined with an overburnt or low bed being fatal to small, fine castings, such as piston rings.

Uneven distribution of blast to tuyeres is sometimes noted in cupolas, the effect being to burn out bricks in one part of the melting zone. One or two tuyeres may be getting less air than the others; this has the same effect as a closed tuyere damper. Where, as the dampers are used in rotation, an air-starved tuyere is in operation throughout the heat, hot gases are forced across from the strong blast side to the weaker, and burning out of the bricks takes place there. Fitting a baffle plate with holes of the same or greater area than the tuyeres in the wind box, cures the trouble. Bends in the blast pipe line should be avoided as far as possible, as they set up resistance to the air.

Tuyere Dampers

Tuyere dampers have been used mostly in European countries for a good many years. Since the introduction of the balanced-blast cupola, their use has become more general. About ten years ago experiments were made with dampers on a small cupola at the author's firm with good results. The cupola had only two tuyere holes without a wind box. Air from a fan was delivered by a divided pipe. By fitting a damper in each leg of the pipe and working each in turn, the capacity of the cupola was increased. It was then decided to fit dampers to a larger cupola; this was done by making cast iron boxes to fit between the inner and outer diameters of the wind box. The boxes were made with a butterfly arrangement to close them, and were controlled from outside the wind box by a lever, which passed over a quadrant drilled with holes to take a pin. Thus the valve could be closed to form a damper or opened and pinned in any position desired. The dampers fitted to the cupola were not entirely successful for two reasons. First, the shape of the tuyeres, and, secondly, the upsetting of the tuyere ratio when one was shut off. The tuyeres were shaped oblong and splayed on the inside to form practically a narrow opening all around the tuyere line. When a damper was closed, the clearing effect took place mostly in the centre of the tuyere opening, leaving the ends dirty; the air blowing from the tuyeres on each side of the closed one being so close to it would not allow the ends to clear.

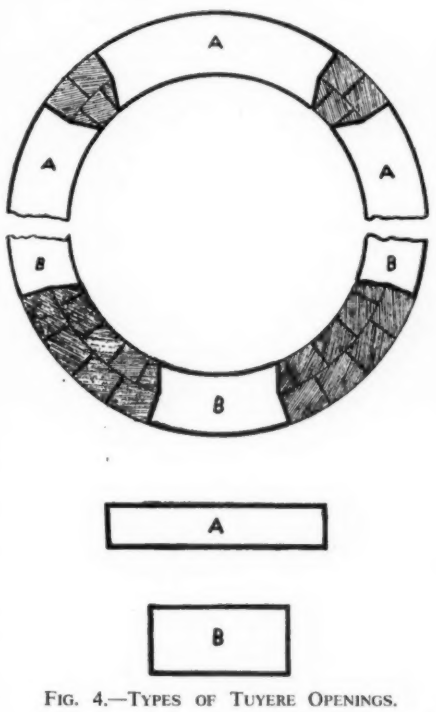


FIG. 4.—TYPES OF TUYERE OPENINGS.

In the second place, where the area of the four tuyeres was a quarter of the cross section area of the cupola, the shutting off of one of them reduced the area by a quarter. This caused the pressure to rise sharply, and a fierce blast from the positive blower offset the value of the dampers. The best shaped tuyeres for cupolas using dampers are round or nearly square ones, as shown in Fig. 4. The long narrow-shaped ones are too close together to get the full clearing effect from dampers.

Dampers operate by shutting the blast off from one tuyere at a time. The blast entering the other tuyeres forces hot gases and flames across to the shut one. All cold slag, splashes of metal, etc., are melted away, leaving the tuyere opening bright and clean. By using the dampers in rotation it is seldom necessary to poke with a bar to clear tuyeres. Excessive poking of tuyeres will unsettle the coke bed and cause dull metal for some time, if not for the remainder of the heat.

Dampers fitted to small diameter cupolas will greatly increase the total capacity of the heat and still "drop" clean. The unpleasant job of chipping out clinker becomes quite easy, and bricks and lining in the melting zone have longer life. It has been noticed that a dirty "drop" is nearly always accompanied by a burnt-out melting zone.

If a damper be closed fully early in the heat, when the tuyeres are very clean, the flames are forced right into the tuyere castings and may cause damage, correct use being to close it just enough to allow the flames to pass up in front of the tuyere hole, level with the cupola lining. After the tuyeres get a little cold slag and coke around them, the damper can be fully shut. Carrying a quantity of slag in the hearth and allowing it to approach tuyere level has an effect on the action of dampers, because the flames blow up from the hearth. When the hearth is kept full to near the tuyere line the clearing action is restricted. (This may be the reason for high tuyere line on balanced-blast cupolas.)

Dampers are a great aid in blowing the coke bed up evenly. On most cupolas, soon after lighting the fire, it will burn up quickly on the fettling door side, because of the extra draft from there. This often leaves the tuyeres on the taphole side quite black. While blowing the fire up for the coke-bed all air is shut off from the dull tuyeres and they quickly brighten up. Thus the bed can be burnt up evenly all over the cupola area.

When designing a new cupola to operate with tuyere dampers, the difficulties experienced with the old cupola, when so fitted, were borne in mind, and steps were taken to overcome them. Total tuyere area was made a quarter of the cross-section area of the cupola, then divided by four to obtain the area of each of four tuyeres, but instead of having four tuyeres, five were fitted.

Supposing the area of each of the four tuyeres was 20 sq. in. instead of having four, five were put in, each of 20 sq. in. This plan enables a damper to be used on each tuyere in turn without upsetting the ratio. The tuyeres are square in shape, slightly splayed on the inside, leaving sufficient space between each for efficient clearing by the flames. In practice, the cupola works excellently, and after the heat a beautiful drop is obtained, only a few pieces of coke remaining on the melting zone walls. As the chipping out and daubing are easily and quickly done, no difficulty is found in obtaining an early start for a large cast. The wind belt is fitted with a baffle plate to distribute the air evenly to each tuyere. The cupola is an efficient and economical unit.

Weighing Charges

Melting metal that is kept within close limits regarding silicon and carbon requires accurate weighing of charges. The furnaceman's assistant's job, under these conditions, becomes an important factor in cupola practice. He has to exercise much more care than when his job amounted to dumping heaps of scrap and pig-iron on the charging platform.

Four or five grades of material may go to make up one charge, such as two grades of pig-iron, scrap, steel, etc. For material hand-charged from a platform, three-sided steel trays or skips are satisfactory equipment. Scales are situated under a mono-rail electric hoist. The skips are placed on the scales platform, and two or more charges are then weighed in one skip without double handling. A weighing chart for each mixture saves time when pounds have to be converted to cwts. and quarters.

Where the tapping ladle used is smaller in capacity than the weight of one charge, the material is weighed in two complete parts. Therefore, if a 2½-cwt. ladle is being used the ingredients are weighed in 2½-cwt. lots, but are charged into the cupola two lots at a time, making a 5-cwt. charge. It will be seen there is a much better chance of obtaining a better mix in the ladle than if the charge was weighed 2 cwts. pig, 2 cwts. scrap, and 1 cwt. steel.

C

* A Paper read before the annual meeting of the Australian Institute of Foundrymen. The author is Head Furnaceman, Russell Manufacturing Company Pty. Limited, Melbourne.

Small Diameter Cupola Practice

The weighing up of special charges and high percentage steel mixtures requires an even grade of scrap and steel for good mixing of molten metal. Heavy scrap and light steel or heavy steel and light scrap make it difficult to get good mixing.

Scrap the same size as pig-iron can be obtained by using cast-iron pig moulds or chills. The castings are made off a full-sized piece of pig-iron. A mould was made off the pig, then a core made in the mould. The core thus obtained is then nailed down into a suitable open oblong mould with a trunnion each end for setting in a frame. If the mould is cast with a fairly high silicon iron they will last for years. Painting daily with a plumbago wash helps to keep them in good order. All metal over after the cast and that over after casting a job is poured into the chills. The unpleasant hot job of breaking up the "over-metal" on the sand floor is avoided, and easily broken, even-sized, clean scrap is available.

Charging

Should a cupola have a long stack—that is, to the charging door—care should be taken (while charging from the bed up to the door) to avoid explosions which can inflict severe burns. As the charges progress up the stack the ignited gases become smothered, causing a gathering of unburnt gases to a point when an explosion can occur. The danger is at the charging door, and the first sign of this is a rising of blue smoke in the stack. This condition, of course, only occurs while charging the cupola to the door before the blast goes on for the heat.

Another danger present while charging is carbon-monoxide poisoning, and as the gas is always present in the cupola an airy charging platform and sufficient height of stack above the charging door to draw the gas off are indicated. It is generally accepted that a 6-in. depth of coke for splits is the minimum that should be used. By filling a ring 6 in. deep and the same diameter as the melting zone with coke, the weight of coke can be obtained. By multiplying the coke weight with whatever ratio it is desired to melt at, the weight of the metal charge is found.

The function of the split is, of course, to replace sufficient coke to bring the bed height up to its level to melt the following charge of metal. If a metal charge is out of proportion to the splits, part of the charge will melt too near the tuyeres, causing dull metal. It is obvious that a charge too heavy for the cupola diameter will cause the first part of the charge to melt higher in the melting zone than the last part. This fault is likely to cause variations in carbon, silicon, etc., also temperature and melting rate. By arranging coke splits, metal charges, and blast to suit the cupola, it can be made to produce hot metal, melted freely, and at an even melting rate.

Coke bed height varies in different cupolas, depending on the class of castings made. Very light castings, such as piston rings, require a higher bed than that for ordinary jobbing work.

The best height is found by experiment, starting with a high bed and reducing daily, until the best level is found. A low bed will cause dull metal, and chill is sure to appear in fine castings. Bed height is partly governed by the type of blast used. Low pressure, mild blast will allow a somewhat lower level to be used. Metal required for very light castings needs a higher ratio of coke to iron for splits than that for heavy castings. The increased coke makes sure of maintaining a high bed, which melts hot, and allows a certain carbon pick-up, with less risk of chill.

The danger period for affected metal is in the early part of the heat; that is, until about five charges have gone through the cupola. This may be so because at the start of the heat the tuyeres are very clean, allowing free oxygen to the melting zone, with a strong oxidising tendency. Piston rings are apt to chill in early metal despite the fact that carbon pick-up is, as a rule, greater in the early metal than it is later on in the heat.

After about four charges are melted, the cupola has settled down to melt, the tuyeres have a certain amount of clinker around them, breaking the rush of air, and the bricks and hearth are properly warmed up. Because of trouble with early metal for rings, a plan was adopted to charge the first five charges at 6:1 ratio, then 7:1 for the rest of the heat. The ratio may appear excessive, but is necessary for the class of work cast. After the first five charges are melted, a reduction of air is possible without decreasing the melting rate; that is to say, melting conditions have reached their peak, and, combined with the reduction of coke, a milder blast is possible. Coke splits should be weighed; high porosity, dry coke charged by measure will result in less carbon in the splits. On the other hand, when weighing wet coke, a few pounds extra should be allowed for water.

Charging Different Grades of Iron

Several grades of metal can be taken out of the cupola during one heat by using coke breaks or boosters. The breaks, to be effective, should be about twice the quantity of the usual splits. Sometimes more is used. When changing from a low silicon iron to a higher silicon mix, or *vice versa*—and it is important the two grades do not mix—a successful method is to allow the cupola shaft to half-empty itself, then put on the break. As the coke and charge is not preheated to the usual extent before reaching the melting zone, a definite break in melting is established.

An example of what was done with one cupola until recently may be of interest. The methods used were standard practice and were adapted to suit shop conditions. A 2 per cent. silicon iron was melted first, followed by a 3 per cent. silicon, then a 1.85 grade, after that 1.5 silicon, and then back to a 3 per cent. grade to finish the heat. Special mixtures would often be melted and separated as well; in some heats, seven or more grades of metal were melted.

Where definite breaks in the melting are carried out, mixtures can be separated accurately and analysis shows very little overlapping or border-line metal. The coke breaks slow up the melting rate, and are likely to give excessive carbon pick-up. If melting a mixture that does not require high carbon, other methods have to be used.

When the range of silicons is not so great, the melting of different grades can be carried out fairly well by counting the number of ladles taken out of the cupola. The weight of metal that the tapping ladle will hold is known, and the amount of iron charged corresponds with so many ladlesful of molten metal. Some overlapping of mixtures may occur, but as the silicons are not so wide apart, it does not matter as much as in the case where the range is from a 1.5 to a 3 per cent. silicon. Some class of castings can usually be found to take the border-line metal.

When melting different grades of iron containing varying percentages of steel, it is best to charge the grades in the order in which they run in silicon content, starting with the highest silicon percentage, and so on to the lowest silicon, or highest steel, mixture. The greatest overlapping is caused by melting high percentage steel mixtures in front of low per cent. steel mixtures or higher silicon grades. This is so, because steel lags behind the pig and scrap in melting. The trouble can be overcome to some extent by uniform section of material in the charges. Excessively large or small sections of steel in relation to the size of the pig and scrap in the charges should be avoided.

When melting standard mixtures apart from special charges, the splits are, of course, all the same size or weight, and good mixing depends on even melting rate, the amount of metal held in the hearth, and regularity of tapping. Hanging up of charges or shutting off the blower will cause bad mixing, as well as reducing the temperature for a few taps. Should the cupola be shut down for more than a few minutes, the charge in the melting zone becomes welded into a large lump. When the blast is put on again, the welded mass is hard to melt. If the charge contains a high percentage of steel, the scrap and pig will melt first. Thus, the first tap after the stoppage will be soft metal and the next very hard. Shutting the blast off for any length of time when melting high tensile iron is fatal to the mixture. Cupolas fitted with forehearths do away with mixing troubles, but do not make it any easier to get out special charges.

Melting Special Charges

Melting a special single charge is best done fourth or fifth from the start. A special charge means that it is for some important castings, and an attempt is made to get the mixture without other charges mixed with it. Also it has to be hot, so that ladle additions, if any, can be added and absorbed thoroughly. Therefore the fourth or fifth charge is chosen, because the cupola then is in good melting condition.

When weighing the "special," care is taken to see that the ingredients are of even size or section. The coke split is increased about a third of the usual weight and the same sized split put on top of the charge to keep the following charge from melting before the "special" can be tapped out.

By counting the taps and finding the break it is known the "special" is about to be melted. A longer period than the usual tapping rate, before opening the taphole is necessary, because of the increased split, and to make sure all the charge is melted. Waiting to make sure all the charge is in the hearth can be done without the danger of the following charge melting down into the "special" because of the increased split on top of the latter.

On cupolas having no forehearths much can be done to ensure good mixing by intelligent tapping of the metal. Using a clock to time the tapping out periods will tell if the melting rate is normal. The cupola will melt a little slower or faster from day to day, depending on the class of coke, size of material charged, and the condition of the atmosphere. The blast can be changed to keep the melting rate the same every day. Where it is desired to hold two tapping ladles full in the hearth throughout the heat a certain amount of judgment is necessary. The tapper-out must know where the different grades of metal are charged, the amounts of each mix, the coke splits, and if any breaks or boosters are used.

Holding metal in the hearth for good mixing can be done by judgment, but to be sure of holding a definite amount at all times during the heat the open slag hole is the best. The slag hole should be high enough from the sand bottom to hold two charges; that is, up to the level of the hole. When the metal shows at the slag hole the tap is made, the metal being allowed to show at the hole again before making the next tap. Using the open slag hole method when melting different grades of metal, care should be taken towards the end of each grade.

By knowing the amount of metal held in the hearth up to the slag hole, and counting the number of taps already taken off, it is known that the particular grade of metal is all melted. It is then all drained out before holding metal to the slag hole for the next grade. When using a coke break or booster split to separate

Small Diameter Cupola Practice

two grades of metal, counting the taps made will tell when the break is nearing the melting zone. It will be noted at this point of the operation slag will show at the taphole, indicating a break in the melting rate, caused by the booster. If the taphole is opened in half the time of the usual tapping rate, where rapid tapping is carried out, and slag shows again, it is then certain that that particular grade is all melted and taken out of the hearth.

Different mixtures can be taken out of the cupola without coke breaks or boosters by charging grades which will blend one into the other so that a certain quantity at the end of one mix may be blended with the start of the next mixture being melted. This border-line metal can be kept down to a minimum by weighing one charge of molten metal in the tapping ladle, and marking the level. When tapping the metal the ladle is filled to this mark, therefore each tap equals one charge, and it is known where each grade of metal begins, and a fair indication of when it is all tapped out.

So as to avoid the weighing of a given quantity in the ladle daily, the ladles are lined to the same size every day by means of a template [consisting of 1½ in. dia. stick]. It is then possible to fix the quantity by measurements. Marks are made in the lining, and each mark represents so many cwt. Much depends on regular tapping for success in separating mixtures, and regular tapping depends on getting the metal cast without undue delay. If the tapping ladle is longer than usual in being emptied nearing the end of one mixture, regular tapping cannot be carried out.

An example (Table I) of analyses obtained when melting a high percentage steel mixture

TABLE I.—*Analysis Spread over a Period of Three Months of 80 per cent Steel Mixture Melted in One Charge between 20 per cent. Steel Charges. Specified Composition : Si 1.20, and T.C 2.95 to 3.15 per cent.*

Date.	Per cent. Si	Per cent. T.C
1940—		
March 11 ..	1.10	3.17
„ 12 ..	1.12	3.17
„ 15 ..	1.13	3.16
„ 29 ..	1.29	2.95
April 15 ..	1.43	2.95
„ 17 ..	1.15	3.04
„ 19 ..	1.27	2.94
May 13.. ..	1.20	3.23
„ 15.. ..	1.41	3.19
„ 16.. ..	1.46	3.10
June 2 ..	1.29	3.18
„ 10 ..	1.36	3.19

between two charges of a much lower percentage steel may be of interest. No coke breaks are used, all splits being the same weight. Close control of melting rate, standard size of ladle, constant diameter of cupola, and regular tapping make for success in getting out mixtures very close to calculated analyses (Tables I and II).

An indication of good melting can be had by observing the gases at the charging door. A blue, pinkish flame indicates good melting. A thick, yellow flame usually means a hang-up of charges in the stack. A definite red flame indicates melting too near the tuyeres or loss of bed.

Slagging

Tapping the slag on cupolas that do not run with the open slag hole can be done quickly by holding a certain quantity of metal in the hearth before opening the hole. If the correct amount of limestone is used to make the slag fluid, it will run out quickly. Opening the slag hole when the hearth is empty of metal, the level of the slag is far below that of the hole, and the operation is slow because of the wait while melting metal to lift the slag to the hole. The melting rate may become slow also, for air is lost at the hole.

Increased pressure of metal at the taphole when melting rate and tapping times are regular is an indication that the slag needs tapping.

TABLE II.—*Repetition Order Job. Medium Percentage Steel Mixture, Close Limits of Analysis Required. Specified Composition : Si 1.80, and T.C 3.30 to 3.40 per cent.*

Date.	Per cent. Si	Per cent. T.C
April 18	1.82	3.40
„ 19	1.80	3.44
„ 22	1.77	3.42
„ 23	1.76	3.39
„ 24	1.76	3.46
„ 29	1.88	3.30
„ 30	1.80	3.41
May 9	1.76	3.42
„ 10	1.77	3.44
„ 13	1.76	3.32
„ 14	1.87	3.34
„ 16	1.82	3.30
„ 17	1.88	3.36
„ 20	1.84	3.36
„ 21	1.84	3.44
„ 22	1.86	3.39
„ 23	1.80	3.39
„ 24	1.83	3.32

Where ladle additions are made slowly in the metal stream in the chute, slagging should be carried out frequently, because the weight of the slag on top of the metal increases the pressure at the taphole, filling the ladle before the additions are made.

Salvaging Porous Castings*

BY FRANK LESS

Very often "leakproof" castings expected to hold a certain pressure are made by good practice and are practically perfect, yet are found to be unable to hold the specified pressure under test. Such castings may usually be made entirely satisfactory by impregnating them with a phenolic resin specially formulated for that purpose, such as Durez 7347A.

In the case of a pump casting, the specifications called for resistance to 500 lbs. water pressure, but inspection revealed sufficient porosity to cause leakage at 100 lbs. pressure. After impregnating with the special resin the casting was found to withstand 800 lbs. water pressure without leakage. The machining cost of £3, as well as the casting itself, was saved at the small cost of the impregnation.

The impregnation is accomplished by forcing the resin into the pores of the casting under air pressure. With small castings this may be done in a suitable pressure tank. Larger castings may be sealed and the resin pumped directly into the casting. Pressures between 45 and 100 lb. per sq. in. should be used.

After the resin has been forced into the casting under pressure, the casting must be baked to "set" or polymerise the resin. Small castings may be baked in an oven for several hours at 250 deg. to 275 deg. F. or preferably in the pressure tank by applying steam at 20 lb. pressure for 2 hrs., followed by 100 lb. for 2 hrs. Baking under pressure will produce a cleaner, smoother surface. Large castings may be baked by applying steam direct at the same pressures.

Durez 7347A resin hardened in this way is practically impervious to water, solvents, mild alkalis and acids. The treatment has been approved by the United States Navy for use on certain types of pump castings.

* From the Shop Notes Section of "Metals and Alloys."

Output of the War Factories

MAKING THE BEST USE OF LABOUR

The Select Committee on National Expenditure have issued a report dealing with the output of the war industries as a whole, which has been prepared by the Sub-Committee on Home Defence Services. It is concerned with the problem of making the best use of labour. A second report will deal with questions of supply, training and transference of labour.

Statements have been made in various quarters to the effect that the rate of output per worker does not compare favourably with pre-war standards, that absenteeism is high, that workers are held up by lack of work, that some workers are not making an effort, and that some employers are inefficient. The Sub-Committee found that although there is justification for these statements at individual establishments, it would be wrong to suppose that they are of general application. At the same time, it can be said generally that the average output per worker is considerably lower than it could be. The urgent needs of the country demand that it should be increased to the maximum. With this end in view the Sub-Committee make a number of recommendations.

Responsibility of the Departments

Departments, they say, must assume a large measure of direct responsibility for ensuring that labour and materials are used to the best advantage. The Industrial Health Research Board should work in the closest co-operation with the production departments. Departments should after consultation with employers and employed decide the maximum number of hours which should be regularly worked in the interests of production and give definite instructions to contractors accordingly. Workpeople should have one day's rest in seven. Factories on the other hand should wherever possible be kept working seven days a week, and negotiations should be conducted with trade unions to make arrangements whereby a six-day week for the workpeople may be fitted into a seven-day week for the factory. Factories and plant should be employed for as much of the 24 hrs. as possible, and the necessary improvements in the conditions of night work should be made. Consideration should be given by departments to the problem of devising arrangements for the adjustment of piece rates which will not discourage improvement in the rate of output. Whenever lack of work is unavoidable, workers should as far as possible be temporarily transferred to other factories, and the assurance should be made widely known among employers that workpeople so lent will return to their own factories as soon as work becomes available again. Employers should be instructed to report temporary surpluses of labour. Managements should take their workpeople more closely into their confidence. In particular, when the lack of work is unavoidable and temporary transfer is not possible, managements should explain, as far as is possible, the cause to their workpeople.

Transport Services

The Sub-Committee stress the importance of adequate transport. They recommend that the Minister of War Transport should have power to regulate the times, frequency and routes of road passenger services in the interests of people engaged in essential work and to require services to continue to run during air raids. The Ministry of Labour should be given power after consultation with the Ministry of War Transport and the Production Departments to require employers and workpeople in suitable areas to devise schemes of staggering of hours, particularly as between factories in the same district. Special passes should be issued to workpeople to give them priority on certain services. All departments should wherever necessary pay fares in excess of 3s. a week to workpeople at any establishment engaged in Government work.

Other recommendations are that there should be careful collaboration between the Ministry of Labour and the Ministry of Food to ensure that movements of population are promptly followed by appropriate diversions of food supplies; that workpeople should have some responsibility for the management of their own canteens; that the work of improving lighting in factories should be expedited; and that efforts should be made to remove misconceptions about income tax and to explain how the Excess Profits Tax operates to prevent profiteering.

Reports on Special-Duty Cast Irons

III—MARTENSITIC CAST IRONS*

By J. G. PEARCE, M.Sc., M.I.Mech.E. (Director, British Cast Iron Research Association)

Introduction

Martensitic cast irons have been developed in recent years on account of the resistance to wear, erosion, and abrasion associated with the martensitic structure, and they are applied in engineering accordingly. As indicated in the Report on Austenitic and Martensitic Irons, martensitic irons can be produced in three ways. An ordinary engineering pearlitic iron can be so heat-treated as to leave some martensite in the structure; such irons can be readily tooled before hardening. These are, however, used in the main for their strength and toughness, and are to be regarded as extensions of the pearlitic class, of Brinell hardness 300 to 350, rather than as martensitic.

Of the martensitic irons specially made and used on account of their resistance to wear, two varieties are possible, according to the state of the eutectic filling around the primary grains, which are martensitic in both. In the harder variety, the eutectic filling is allowed to solidify white, or cementitic; in the less hard variety the eutectic filling is allowed to solidify grey, *i.e.*, graphitic. The former permits the use of irons harder than the white or cementitic irons; the latter permits the use of irons of hardnesses between those of the pearlitic and cementitic irons.

Thus martensitic cast irons are divisible into two main classes, white and grey in character respectively. Those described as grey may be made martensitic in the as-cast condition, or may be heat-treated to give a similar structure.

TABLE I.—*Transverse Strength of Chilled Cast Iron and Ni-hard Iron.*

	Plain chilled cast iron.		Ni-hard.	
	Breaking load, lb.	Modulus of rupture, tons per sq. in.	Breaking load, lb.	Modulus of rupture, tons per sq. in.
Transverse strength in chill-cast bars	4,000 to 4,500	31 to 35	5,000 to 6,000	39 to 46
Transverse strength in sand-cast bars....	3,000 to 3,500	23 to 28	4,000 to 4,500	31 to 35

Commercial Martensitic Cast Irons

While a great deal of experimental work has been done on the production of the less hard, or grey, variety of martensitic iron, the greater industrial need has been for the harder variety, and it is for this type that the bulk of the information recorded is available. The type has various trade names, but is best known as Ni-hard. The essential feature of the composition is about 4.5 per cent. nickel and 1.5 per cent. chromium; the other elements resemble those in chill-cast irons, the silicon being relatively low. For the highest hardness, the carbon content is raised to a maximum, and for the highest strength it is lowered to a minimum; while in general the carbon and silicon contents are higher in small (and hence in rapidly cooled) castings, and *vice versa*.

* Prepared for the Research Committee of the Institution of Mechanical Engineers on High-Duty Cast Irons for General Engineering Purposes, and reproduced by kind permission of the Institution.

The resistance to wear, erosion, and abrasion which is characteristic of martensitic cast irons has brought about their employment in a number of engineering applications. Martensitic cast irons may be produced by heat-treatment of an ordinary engineering pearlitic iron; or they may be specially produced and so treated that either of two varieties can be obtained. In one such variety the eutectic filling surrounding the primary grains is allowed to solidify white (cementitic), and in the other it is allowed to solidify grey (graphitic). There are thus two main classes of the martensitic cast irons which are specially made as such; they may be respectively described as "white" and "grey" in character, the former being the harder of the two. The "grey" variety can be made martensitic in the condition as cast, or, alternatively, a martensitic structure can be produced in it by suitable heat-treatment.

Ni-hard irons are not usually required for their resistance to corrosion or heat, but for their resistance to wear, erosion, and abrasion. They do not offer any increase in ductility or elongation over the ordinary engineering grey irons.

MECHANICAL PROPERTIES

Information gathered from various reliable sources shows that martensitic irons, typified by Ni-hard have the following mechanical properties:—

Transverse Strength

The transverse strength of a typical Ni-hard cast iron has been compared with that of a plain chilled cast iron; all tests were made on 1.2-in. bars, stress-relieved after casting at 230 deg. C. for 3 hrs. (Table I).

TABLE II.—*Tensile Strength of Plain Cast Iron and Ni-hard Iron.*

	Plain cast iron.		Ni-hard.	
	3.5 per cent. carbon.	2.75 per cent. carbon.	3.5 per cent. carbon.	2.75 per cent. carbon.
Tensile strength, tons per sq. in.:—				
(*a*) Chilled section....	16 to 18	21 to 24	25 to 27	31 to 36
(*b*) Grey core....	7 to 11	10 to 17.5	13 to 16	18 to 22
Brinell hardness number (chilled face)	500	400	650 to 700	575
Shore hardness (chilled face)	70	55	90	78

Tensile Strength

The tensile strength of the martensitic iron, Ni-hard is compared in Table II with that of an ordinary cast iron.

Impact and Shock Strength

Castings containing small amounts of martensite have quite a good resistance to shock and impact, but this resistance decreases with increase in martensite, although the values are at least as good as those of many engineering grey irons.

Hardness

A martensitic iron is much harder than an ordinary chilled cast iron, as shown above.

Machinability

Cast irons containing moderate amounts of martensite can be machined successfully, using special equipment; but with considerable amounts of martensite, they are by ordinary standards unmachinable. When special arrangements can be made regarding the robustness of the machine, choice of tool, and speed of cut, martensitic irons with Brinell hardness numbers up to 500 can be machined with a relatively high cutting speed. This difficulty can be overcome, where necessary, by casting a material of suitable composition, machining the as-cast material, and then, by simple heat-treatment, converting it to the martensitic condition. In a recorded case, an iron was cast in the austenitic state and transformed after machining to the martensitic condition. Thus, an iron containing 6.5 per cent. nickel and 3.75 per cent. manganese, and having a tensile strength of 12.8 tons per sq. in. and a Brinell hardness number of 160, was treated at 600 deg. C. for 15 hrs. to give a tensile strength of 20.6 tons per sq. in. and a Brinell hardness number of 418.

The heat-treatment of Ni-hard type irons shows that an as-cast hardness (Firth diamond number) of 488 can be raised to 700 to 800 by oil-quenching from 750 deg. C. This hardness drops as the quenching temperature is raised, and the hardness on quenching from 950 deg. C. is about that of the as-cast condition. Quenching from still higher temperatures softens the material, but the hardness can be restored and even increased by tempering, and the higher the tempering temperature, the greater is the restoration. Low-temperature heat-treatment also has interesting effects. While the hardness is little affected, the strength is increased. In a recorded case, an iron with an as-cast transverse rupture modulus of 29.4 tons per sq. in. had this figure increased to 45.6 tons per sq. in. on treatment for 10 hrs. at 600 deg. C., followed by slow cooling. Ordinary annealing increases the hardness; in one case 16 hrs.' treatment raised the hardness (Firth diamond number) from 488 to 534 and in another from 488 to 551.

Hard Facing by Welding On

Ni-hard can be used as a hard facing or surfacing material, which is applied by welding, to build up an abrasion-resistant surface.

Resistance to Wear

The martensitic irons—Ni-hard being typical—owe most of their commercial applications to their resistance to erosion, abrasion, and wear, together with their great hardness. Resistance to wear, however, depends not only on the intrinsic properties of the material, but also upon the external conditions under which the wear takes place, and the results obtained from wear tests apply only to the conditions under which the tests were made. While, however, it must not be assumed that similar results will be obtained in every case, some illustrations will serve to provide suitable comparisons.

Ni-hard has six to eight times the abrasion-resistance of ordinary unalloyed white cast iron.

Tests have been carried out on linings in a rotary ball mill employed in the crushing of chilled white cast iron for the manufacture of chilled metallic grit, used in shot-blasting and cleaning operations. The material fed into the mill for crushing was drastically chilled, and treated to give a tough martensitic structure,

(*Concluded on page* 154.)

STANTON-DALE

Refined

PIG IRON

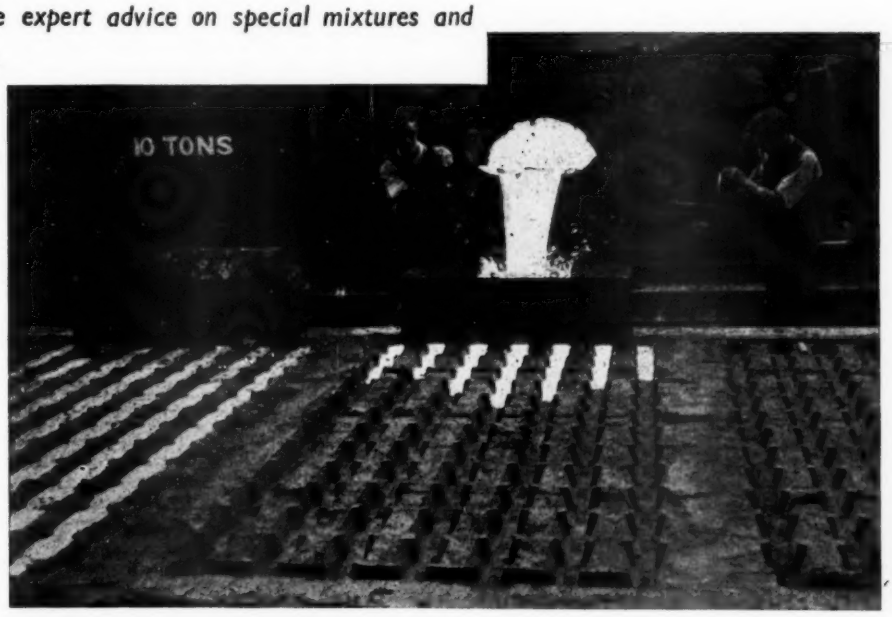
IS CHARACTERISED by closeness of grain structure, uniformity of composition and fine graphitic carbon evenly distributed.

IS PRODUCED to guaranteed analysis in seven standard grades.

CAN BE MADE to customers' individual requirements with total carbon from 2·6 per cent. upwards.

SHOULD BE USED to tone up high phosphorus irons and scrap, to replace Hematite, and to produce castings for all high duty purposes.

Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

The Acid Resistance of Finished Enamelware

RECOMMENDED METHOD OF TESTING

(*Concluded from page 93.*)

Discussion of Previous Report

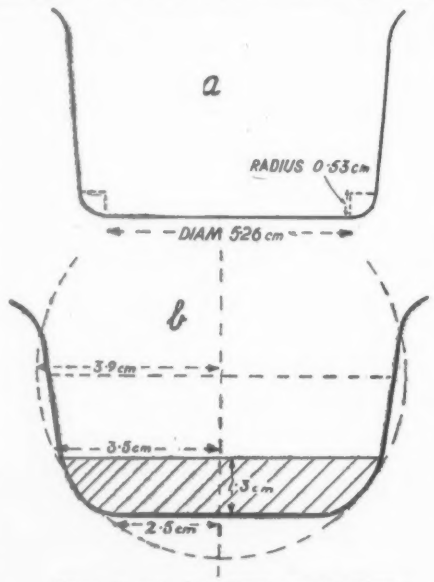
The report entitled "Recommended Method of Testing the Acid-Resistance of Vitreous Enamel" produced discussion, and suggestions from various persons and bodies connected with the points of view of the different sections of the industry have been very helpful. A number of points discussed by the Sub-Committee, although not published in the report, were raised, and it was possible to clear up a few misunderstandings that appeared to exist.

Thus it was explained that the test described was for vitreous enamel and not for vitreous enamelled articles directly as such, although by processing of test-pieces along with the normal ware, it can be used as a routine check on enamelling conditions. Although the test was devised particularly for the use of the simplest apparatus and methods, it still remains a test for which laboratory facilities are required, and was criticised as not being a "practical" test. In order to obtain a quantitative result, some reasonably accurate measurement is required, and a balance is likely to be the most accurate instrument in use in the average laboratory.

Another comment arising from the publication of the previous report was that the results included might be misinterpreted by consumers of vitreous enamelled goods, and others outside the industry. The suggestion was made that the figures in Table II in that Report were liable to make consumers place a false value on acid-resistance, and demand A.R. enamels for articles on which non-resistant enamels had so far proved quite satisfactory, thus increasing costs and production difficulties for the enameller. It was, perhaps, unfortunate that this misunderstanding should occur, as in the interest of the industry, the Sub-Committee has on all occasions refrained from making any suggestions regarding types of enamel suitable for different purposes, and has confined its work to the drawing up of a test, from the results of which individual interpretations and conclusions can be drawn. It is hoped that the extended table of results now published will help to show the wide range of applicability of the test and give some idea of the types of enamel at present in use on various types of commercial enamelled products.

It has been suggested that the result of any test on a test-piece cannot bear a direct relation to that obtained from a piece of production ware, as the properties of the enamel are so much affected by processing conditions, such as fusing time and temperature. This can be used as an argument in favour of a test to be carried out under standard conditions, which are as far as possible ideal. Naturally, special care is taken in the preparation of such test-pieces, in order that the results should be consistent, and the fact that some care is necessary cannot be regarded as an objection to a quantitative test.

At a meeting where the Sub-Committee's first Report was discussed, it was emphasised that a cast iron enamel should always be tested on a cast iron basin. While this had always been done, it was thought worth while to try the effect of cast iron enamels applied to sheet iron basins. It was found that a non-resistant cast iron enamel (No. 27) normally fused on cast iron for 15 min. at 760 deg. C., required 3 min. at 820 deg. C., and 5 min. at 760 deg. C. when fused on sheet iron, and the resistance figure was changed from 370 to 360 and 270 respectively.



FIGS. 4A AND 4B.—BOWL UPON WHICH CALCULATIONS WERE BASED.

In the case of a resistant enamel, also requiring the same fusing conditions, the acid-resistance was reduced by fusing on sheet metal from 20 to 26 and 31 respectively. This pronounced and variable effect of the time of fusing confirms the importance of the "maturing" of enamels during the fusing process and the need for cast iron basins for testing cast iron enamels.

Some discussion arose regarding the type of test-piece adopted, and it appears that the reasons for the adoption of the small basin were not sufficiently explained. Thus, in favour of a tubular test-piece, it was suggested that the area is more easily calculated and is larger in proportion to the weight than for a basin, the smaller weight leading to increased accuracy of weighing. Four important points in the choice of a basin are:—

(1) *Ease of Fabrication.*—The making of a tubular sheet iron test-piece involves welding, which must be carefully carried out in order to avoid enamel defects. A basin is made by spinning or pressing, or cast from a pattern.

(2) *Availability of Material.*—At the present time, sheet metal is much more readily obtainable than tubing of the required quality.

(3) *Ease of Preparation.*—The basin more closely resembles a production piece than a tube does, and can be pickled, coated and fused by normal production methods in a works plant.

(4) *Simplicity of Apparatus.*—The basin requires less additional apparatus and a simpler procedure, and is more convenient to handle than a tube.

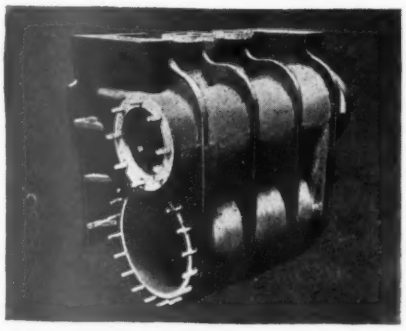
Compared with these advantages, the advantages for the tubular test-piece of ease of calculation of area and greater area for a given weight, are greatly diminished. They are taken care of by using a standard basin, the ratio of area to weight of which is sufficiently high for adequate accuracy. The basin was adopted for the Sub-Committee's preliminary experiments, before quantitative methods were fully worked out, and proved so convenient in preparation and handling that its use was continued, the shape being so arranged that 40 ml. of solution covered approximately 50 sq. cm. of enamel surface. A series of calculations was carried out in order to ascertain how the exact shape of the basin affected this figure.

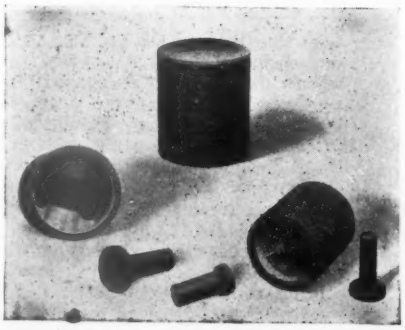
Shape of Test-Piece

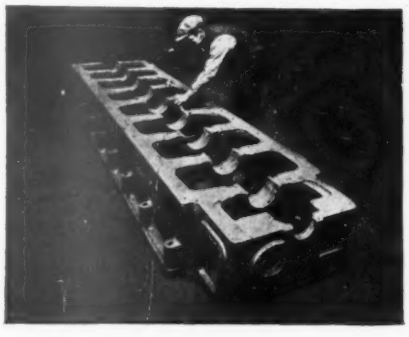
The type of bowl recommended for the standard test, while being very convenient to make and handle, is not of a simple geometric shape. In vertical section it has a curved side joined to a flat base, its surface being made up of a curved solid of revolution and a plane circular disc. It approximates in shape more closely to a cylinder than to a hemisphere, and its area in relation to its volume is greater than that of a hemisphere and less than that of a cylinder of equal volume.

Due to variations in manufacture, the bowls supplied may not be identical, and the thickness of enamel will introduce a further source of variation. It is important that the shape should be such that small variations in the dimensions will not seriously affect the accuracy of the test, so this was investigated mathematically. For a true spherical shape, it can be shown that for a given volume of liquid, the variation in the area of contact resulting from and in relation to a known variation in the radius, is zero, when the radius is such that the liquid fills the hemisphere, but with increase of radius, the variation in the area of contact eventually becomes approximately half that of the radius. For a true cylinder, it is found that when the depth is equal to the radius, the area of contact is independent of small variations in the radius. The actual test-bowl approximates very closely to a hemisphere cut by a plane surface, but the equations for the condition that the area of contact of such a surface is independent of the radius are very complicated and cannot be solved exactly. In the case of a truncated cone, the inclination of the sides slightly reduces the ratio of the depth to the radius when the variation of area with radius is at a minimum.

Sample test-bowls finished in wet-process white enamel were measured, the area being the sum of those of the base, the sides and the ring joining them, while the volume is the sum of those of a cylinder standing on the base, the ring surrounding it, and a truncated cone formed by the sides (Fig. 4a). Measurements of the area of contact and volume of liquid were made at different heights, and







UCO CYLINDER IRONS

Foundrymen who have to meet high-duty specifications are more than half-way to their requirements if they start in the cupola with UCO Cylinder Irons.

These are virgin irons, low in carbon and silicon. They have not been remelted, nor has scrap or steel been added. UCO Irons possess the well-known excellent Hematite characteristics. Because they are machine cast they are 100% usable iron, without sows, and free from adhering sand.

UCO Irons give strong, close-grained and uniform castings, free from porosity, resistant to wear and to heat, easily machined.

Write for a copy of "Workington & Distington Hematite Irons," Ref. W.220, which gives analyses and properties of UCO grades.

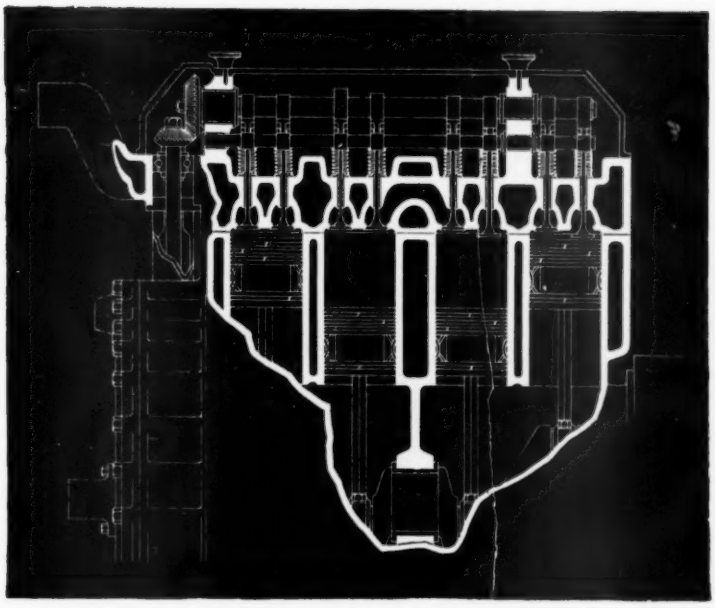
THE UNITED STEEL COMPANIES LTD

WORKINGTON IRON & STEEL CO.

Branch of The United Steel Companies Limited

WORKINGTON **CUMBERLAND**

Telephone: Workington 206 *Telegrams: "Mosbay" Workington*



W.52

graphical representation showed that a volume of 40 ml. has an area of contact of about 50.5 sq. cm. Calculations were then made with uniform increases in diameter of 1 mm. and 2 mm. at all cross-sections, and it was found that except for very shallow depths (below 1 cm.) the values of area and volume are close to the previous ones, so that the area of contact for a fixed volume of 40 ml. is not appreciably altered by a variation of even 2 mm. in the diameter.

Fig. 4b shows an alternative method of calculation, the lower part of the basin being considered as a hemisphere cut by a plane surface. The area of contact is made up of a circle and a zone of a sphere. Basins taken at random from batches from two different sources gave contact areas of 51.4 and 50.5 sq. cm. respectively by graphical representation and calculation by this method.

Testing Solution

Although the choice of oxalic acid as the testing medium was generally approved, it was suggested that it bore no relation to the acids likely to be encountered in the use of enamelled products. It was also suggested that the use of another acid would not necessarily place a series of enamels in the same order. To check this point, tests were made on a white and green enamel with acetic, phosphoric, oxalic and sulphuric acids, each at 3 per cent. concentration, following the procedure adopted in the recommended testing method, without determining the weight of residue. The results showed that the different acids agreed in rating the green enamel as more resistant than the white, and that the degree of attack by the different acids was in the same order for each enamel, and approximately in the same proportion. With acetic acid, however, there was a marked deviation from proportionality, showing that a small degree of attack gives a less reliable numerical expression of acid-resisting properties. The results are given in Table III as loss in weight of bowls (mg./sq. dm.).

TABLE III.—*Bowl Tests with different Acids.*

Acid.	Green Enamel.		White Enamel.		Ratio Green/White.
	Actual Loss. mg. per sq. dm.	Per cent. of H_2SO_4 Loss.	Actual Loss. mg. per sq. dm.	Per cent. of H_2SO_4 Loss.	
Acetic	4	3.8	12	0.7	0.33
Phosphoric ..	14	13.2	224	13.9	0.063
Oxalic	37	34.9	840	52	0.044
Sulphuric	106	100	1,616	100	0.066

TABLE IV.—*Tests Carried Out for Two-hour Periods.* (*Value in mg. per sq. dm.*)

Period No.	Non-resistant Enamel (No. 1).				Resistant Enamel (No. 3).			
	Loss.	Total Loss.	Residue.	Total Residue.	Loss.	Total Loss.	Residue.	Total Residue.
1	266	266	314	314	22	22	26	26
2	222	488	210	524	6	28	10	36
3	208	696	232	756	8	36	6	42
4	178	874	178	934	8	44	6	48
5	188	1,062	174	1,108	4	48	8	56
6	166	1,228	174	1,282	4	52	6	62

It was suggested by one member of the Institute that many commercial acid-resisting enamels would give very similar results when tested by the recommended method, and it might be better to test with two different acids, in the hope of obtaining sharper distinctions between the different enamels. It is considered that this complication would not be worth while—a view given support by the above figures.

Although the original Report specifies that the oxalic acid used must be pure, and give no residue on ignition, it is thought advisable to emphasise this, as it has been reported that during the last war, oxalic acid proved to be a very variable reagent.

Time of Test

Some discussion took place regarding the time for which the hot acid is left in contact with the enamel, suggestions being made in favour of both a shorter and a longer time. In favour of a longer time, it was maintained that the time limit should be fixed to allow for the attack reaching a maximum. On the other hand, the time of one hour, it was said, might tend to reduce the difference between some types of enamel. A more complete explanation of the choice of one hour therefore seems advisable. It was necessary first to decide whether the acid-resistance of vitreous enamel was to be characterised by its ability to resist prolonged attack (even though its appearance was spoiled in a short time) or its ability to resist attack which spoiled its appearance (but left its protective value comparatively unimpaired). Since in the majority of cases appearance is generally considered the more important, the second method was chosen. Although it was hoped to include all types of enamel on the same scale of resistance, it was realised that such a method would not necessarily give complete definition of enamels intended purely for protective purposes, which are best tested under conditions reproducing actual service. The time of one hour was adopted for the following reasons:—

(1) It is the maximum time that can reasonably be demanded for such a test, and has, in fact, been stated to be too long. A longer time would unduly accentuate the difference between enamels of high and low resistance, due to the difference in the method of attack. If the strength of the acid is maintained, the attack on a poorly resistant enamel continues indefinitely with very little diminution. No definite maximum was reached when tests were carried out over a period of several hours. In the case of acid-resisting enamels, however, the attack all takes place near the beginning of such a period and then diminishes almost to zero. Fig. 5 shows curves for the two types of enamel over a period of two hours, measured in separate periods of 20 minutes. The figures on which these curves are based are given in Table IV (all in mg./sq. dm.).

The choice of a time suitable for all types of enamel is therefore in any case based largely on compromise.

(2) A shorter time than one hour might lead to errors from inaccurate timing, or different conditions during the cooling and removal of the acid.

Expression of Results

Other points raised dealt with the method of expression of the results, and the use of the weight of residue as a measurement of the degree of attack. It was not considered desirable to express the results of the test on a scale of 0 to 100 on account of the difficulty of deciding the limits of the scale, and the inadequate representation of the great differences between different types of enamel. With regard to the determination of the weight of the ignited residue, and its relation to the loss in weight of the basin, it is natural to expect that only in exceptional cases would the two figures agree exactly. Both were included in the test because:—

(*a*) It might prove difficult to weigh some cast iron basins to the required degree of accuracy when testing a very resistant enamel. (The basins actually used weighed about 90 g. for sheet iron and 180 g. for cast iron.)

(*b*) When the enamel is strongly attacked, it is difficult to dry and accurately weigh the basin, due to rapid absorption of moisture by the enamel.

(*c*) It was hoped to devise a means of applying a similar type of hot acid test to finished enamelware, by means of suitable apparatus, in which case determination of the loss in weight would not have been possible.

Oxides dissolved from the enamel by the acid are converted into oxalates, which on ignition are changed to oxides. Solid material may also be formed by disintegration. In the case of the alkali metals, the first products are carbonates, which are not decomposed themselves but react with the silica of the crucible to form silicates, thus being weighed as oxides. In one case where the loss in weight of the basin was significantly less than the weight of residue, a known amount of pure ground silica was added to the crucible before and also during ignition, but it did not remove the discrepancy. Colour oxides may or may not be affected by the acid, and greater differences can be expected, *e.g.*, enamel No. 15 in Table II.

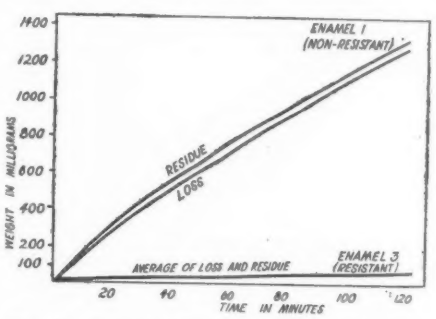


FIG. 5.—SHOWING TEST RESULTS ON ACID AND NON-ACID RESISTANT ENAMELS.

A suggestion was made that the residue of oxides should be converted into chlorides by heating with hydrochloric acid. Although this would definitely lead to the production of compounds of known composition, it was considered that the weight of such residue would bear an even less exact relation to the loss in weight of the basin, on account of the different valencies of the elements involved, and hence the formulæ for their chlorides.

Since the silica of the crucible plays a part in the reactions involved, it would be expected that a platinum crucible might give a different result. In practice it was found that in one case the loss in weight of the bowl and the weight of residue were similar, *i.e.*, 706 and 772, but in another case the values were different, being 12 and 22 mg./sq. dm. respectively. Platinum crucibles should therefore not be used for the test.

A more complete specification of the silica crucible than that previously given can be that given in British Standard Specification No. 875, *i.e.*, squat shape, capacity 15 ml., 24 mm. high and 40 mm. diameter.

Pig for Victory

We have amended the popular slogan because most of the qualities required for victory are inherent in Warner Pig Iron.

Toughness — Resistance to wear and tear—Strength—Uniformity — Reliability—and Economy, to mention but a few.

Admittedly, we can think of no spiritual virtues which Warner Pig Iron can contribute to the winning of this war — although our artist obviously regards it as pig-headed and we can at least hope that this will confirm the worst suspicions of the enemy regarding everything British.

Warner's

Special Pig Irons

WARNER AND CO. LTD., CARGO FLEET, MIDDLESBROUGH

The Week's News in Brief

Trade Talk

PATTERNMAKERS and fitters employed at time rates in railway workshops have been awarded another 1s. a week by the Industrial Court.

THE BOARD OF TRADE have made an Order prohibiting the export of any goods except under licence to China, the Japanese Pacific Islands and Macao.

DURING AN R.A.F. attack on August 21 on an iron and steel works at Ijmuiden, direct hits were obtained on the rolling mill and other parts of the works.

REPRESENTATIVES of the employers and of the Amalgamated Engineering Union discussed points of difference with regard to wages in the engineering trade at a conference in London last week.

THE DISTRICT CHEMICAL COMPANY, LIMITED, has changed its address from 52-54, Leadenhall Street, London, E.C.3, to Commonwealth House, 1-19, New Oxford Street, W.C.1. The new telephone number is Chancery 6041 (10 lines).

JOHN A. SMEETON, LIMITED, of 76, Auckland Road, Upper Norwood, London, S.E.19, has concluded an exclusive agreement with Kitson & Company, Limited, of Airedale Foundry, Leeds, for the manufacture of the well-known "Collin" foundry ladles.

CARRON COMPANY has opened a canteen for their employees of the Mungal Foundry and the Carron engineering works. The canteen will be open day and night. It was formerly a recreation room. The latest cooking equipment has been supplied by the company.

UNDER A BOARD OF TRADE ORDER which comes into force on September 11, licences will be required to export to all destinations non-ferrous metals in the form of leaf and foil. The Order also prohibits the export without licence to certain specified destinations of fluorspar.

"JOHN DALE, LIMITED," is the new title of John Dale (Metal Containers), Limited, of Brunswick Park Road, New Southgate, London, N.11. The change has been deemed desirable owing to the increasing ranges of their activities, which include the manufacture of light alloy castings.

BRITISH ROPES, LIMITED, Anchor and Hope Lane, Charlton, London, S.E.7, inform us that they have developed a fibre substitute for baling wire called "Balax." The use of this fibre substitute for baling wire effects a saving of something over 20 per cent. in baling costs owing to the fact that there is three times more yardage in a ton of Balax than there is in a ton of baling wire.

PERSONS HAVING claims against Finnish ships, shipowners or charterers are reminded that under the Cargoes and Claims (Information) Order (S.R. & O. 1940, No. 1568), they are required to report particulars to the Secretary, Enemy Shipping Claims Committee, Norman House, Strand, London, W.C.2. Persons not sending the required particulars are liable to penalties under the Defence Regulations.

PURCHASE TAX.—Under decisions regarding the liability of certain articles to tax, it is now announced that water jacketted urns with an interior capacity of two gallons or more, insulated lined urns, oval and double lined counter urns, counter water boilers, combination counter sets consisting of urns and boiler, and lead-plugged weights and Government-stamped weights are not subject to the Purchase Tax.

AN IMPORTANT STEP has been taken in the plan to "telescope" the Sheffield cutlery industry. The Board of Trade has issued a first list of 28 nucleus firms which will receive certificates from the Board entitling them to remain in business. If they are not producing to capacity, they may be asked to incorporate the production of factories not on the list. Firms not on the list may make representations with a view to being granted a nucleus certificate, or to discuss proposals for their businesses to be taken over by nucleus firms.

LORD BEAVERBROOK, Minister of Supply, who has just returned from America, stated at a Press conference that United States armaments production was increasing rapidly, and that it would not be long before it assumed very large figures indeed. There were certain imports from the United States that we had decided to abandon for the time being, particularly iron and steel scrap. We were giving up the collection of such scrap in America and taking it up to a greater degree here. He expressed the hope that there would be a good response by the public in this country and that there would be a continuous flow of supplies. It had been necessary to curtail our imports because of America's growing programme. We might also limit our imports of pig-iron and receive instead more finished products. We should have to increase our own production of pig-iron to some extent.

WITH the Workmen's Compensation Scheme being more embracive from January 1, 1942, when non-manual workers are brought in with earnings up to £420 (from £350), manual workers being included whatever the earnings, it may be useful to remind readers that although insurance is not compulsory and there is no Government insurance scheme, as with the other social insurance schemes, there is an arrangement between the Home Office and the Accident Offices Association, whereby premiums are adjusted each year if insurance is taken out with a member of the Association (most companies are members). For the year ending December 31, 1940 (the current operative accounts), the premiums side returns £6,825,193, the losses side £3,949,187, thus the actual loss ratio works out at 57.86 per cent., giving a difference from the basic 65 per cent. of 7.14 per cent. Consequently, there will be a rebate of 7.14 per cent. on all premiums falling due between July 1, 1941, and June 30, 1942.

Personal

SIR LYNDEN LIVINGSTONE MACASSEY, K.C., has been appointed a director of the Projectile & Engineering Company, Limited.

MR. R. J. BARCLAY has been appointed managing director of Markham & Company, Limited, colliery and general engineers, of Chesterfield.

TO MARK the occasion of their recent marriage, Councillor Wilfred E. Hale and Mrs. Hale have been presented by the employees of the Walsall Transport Department with a silver tea service. Councillor Hale is one of the principals of the firm of Hale, the well-known ironfounders in the district.

MR. C. K. EVERITT, chairman of Edgar Allen & Company, Limited, Sheffield, and Mrs. Everitt, have celebrated their golden wedding anniversary. Mr. Everitt began his long association with Edgar Allen & Company, Limited, in 1881. He became manager of the steel department, was made a director of the company in 1908, and chairman in 1929.

MR. JOHN ADAM, a student of the Royal Technical College, Glasgow, and an apprentice draughtsman with David Rowan & Company, Limited, has been awarded the scholarship in marine engineering offered annually by Lloyd's Register of Shipping on the results of an examination held under the auspices of the Institute of Marine Engineers. The scholarship is tenable for three years at a British University.

Wills

CLARK, F. C. B., of Chelsea, lead manufacturer	£141,281
FERNS, W. E. C., of Ilkley, Yorkshire, partner in Hick, Ferns & Company, iron and steel merchants, of Otley	£2,344
HENDRY, J. C., director of Lamberton & Company, Limited, engineers and iron and brass founders, Coatbridge	£6,352

Obituary

MR. SIDNEY ROYSE LYSAGHT, who for many years was associated with John Lysaght, Limited, has died at Mallow, Co. Cork. He was one of the first directors, and at one time was manager of the Bristol works. He was a brother of Mr. W. R. Lysaght, of Chepstow, who was head of the firm founded by his uncle until his resignation last year.

MR. WILLIAM ROSS HUTTON, general manager of R. & W. Hawthorn Leslie & Company, Limited, shipbuilders, Hebburn-on-Tyne, has died at a Newcastle hospital after a brief illness. He was 65 years old. Mr. Hutton was born at Stirling and served his apprenticeship with Barclay Curle & Company, Limited, Glasgow. He became shipyard manager at Hebburn in 1907 and after the 1914-18 war was appointed general manager.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Hope Foundry (Stoke), Dragon Square, Chesterton, Staffs—£1,000.

Constructional Erection—Structural steel erectors, etc. £2,000. E. C. and J. C. Bisgood, 36, The Drive, Leeds, 8.

Wrenn, Gill & Company (Engineers)—£2,500. L. A. Wrenn, 14, Glasbrook Avenue, Whitton, Middlx., and E. A. Gill.

Bucks Die Casting Company—£1,000. J. R. Hunt, Greeba, London Road, Slough, Bucks; C. G. Clack and H. A. Hancock.

Knapp & Bates, 24, Coleman Street, London, E.C.2—Metallurgical, mechanical and mining engineers, etc. £5,000. E. A. Knapp, W. R. Bates, and B. Reyner.

Humphrey & J. Fox & R. H. Morgan, Century Works, Moat Street, Willenhall—Lock manufacturers, die sinkers and tool makers. £15,000. H. Fox, C., R. H., and N. C. Morgan.

Reports and Dividends

W. Canning—Interim dividend of 5% (same).

Bairds & Scottish Steel—Interim dividend of 2% (3%).

Qualcast—Net trading profit, £112,342 (£99,663); final dividend of 10% and a 10% cash bonus, making 30% (same).

Brightside Foundry & Engineering Company—Dividend of 15% on the ordinary shares, plus a bonus of 10%, for the year ended June 30.

Davy & United Engineering—Net profit for year to March 31, £51,659 (£69,006); dividend on the ordinary shares of 7½% (1s. 6d. per share), less tax £117,238.

Darwins—Trading profit, after tax, for the year to March 31, £96,886; depreciation, debenture interest, etc., £44,853; reserve against losses in enemy-controlled countries, £19,220; net profit, £32,812; to general reserve, £18,104; dividend of 5%, £12,729; forward, £2,350 (£370).

Contracts Open

Hay, September 17—Provision and laying of approx. 1,200 yds. of 3 in. dia. spun-iron rising main, etc., for the Urban District Council. Mr. R. Trevor Griffiths, clerk, Council Offices, Belle Vue, Hay, via Hereford.

Malvern, September 19—Electrical centrifugal pumping set to deliver 10,000 galls. of water per hr., against a head of 420 ft., for the Urban District Council. Mr. C. C. Judson, surveyor, The Council House, Malvern.

Middlesbrough, September 10—Venturi meters and recorders, for the Tees Valley Water Board. Mr. T. S. R. Winter, acting general manager, Water Board Offices, Corporation Road, Middlesbrough. (Fee £2 2s., returnable.)

Salisbury, Rhodesia, September 29—Supply, delivery and erection of two 2,500-kw. turbo-alternators and exciters, with condensing and auxiliary plant, for the City Council. Merz & McLellan, 32, Victoria Street, London, S.W.1. (Fee £5 5s.)

Torquay, September 8—Electrically driven centrifugal pump, with a delivery of 400 galls. per min. against a head of 210 ft., for the Borough Council. The Water Engineer, Town Hall, Torquay.

Control of Iron and Steel

The Ministry of Supply has issued the Control of Iron and Steel (No. 15), 1941, Direction No. 2, which came into force on August 31, and extends until September 30 the period during which orders for all iron products except pig-iron, but including iron castings, may be fulfilled without being authorised by the responsible Government department. This extension applies only to orders placed before September 1, 1941, which would not if the No. 8 Order had remained in force have required to be licensed. The exemption from licence or other authority of small purchases of iron castings has been extended from quantities not exceeding 2 cwts. to quantities not exceeding 5 cwts.

Copies of the Direction may be obtained from H.M. Stationery Office.

BASIC BRICKS: Spinella, Saxpyre, Supermag, Diazite, Dolomax.

•

SILICA BRICKS: Lowood, Meltham, Allen, Quartex.

•

FIREBRICKS: Glenboig Special, Glenboig Special Crown, Glenboig, Glenboig Crown, Castlecary, Dykehead, Gem, White Carr, Stour, Hycone.

Alumantine, Hysilyn, Adamantine, Llangennech.

•

CEMENTS: Sintex, Durax, Pyrolyte.

•

INSULATION: Amberlite Bricks, Cement & Concrete.

•

SANDS: Moulding, Brick Facing, Silica, Glass.

•

PLASTICS: Durax, Rotaline, Plastic K-N, Glendoline, Ground Ganister.

•

SILLIMANITE: Tank Blocks, Bricks and Cements.

•

ACID-PROOF REFRACTORIES: Obsidianite, Losol.

•

. . . both bring their Refractory problems to General Refractories

BETWEEN users who exercise meticulous care and foresight in the selection of refractories and those who buy 'cheaply' regardless of quality—there are large numbers who acknowledge the value of a suitable refractory for their business, but lack the specialised knowledge, equipment and staff to compare refractory values. To them the General Refractories organisation has much to offer. For example, the "G.R." range of products will provide maximum service and efficiency for any stated purpose—"G.R." laboratories and staff are qualified to understand the problems of a user, to recommend the correct product and supply sound reasons for its selection. Thus users are assured of impartial and helpful service in selecting refractories. The continually increasing number of firms who make use of the "G.R." Technical Advisory Service is significant of the growing importance placed by users on the sound selection of refractories. With the changes imposed by war-time supplies of raw materials and production conditions, the vast resources of General Refractories are a definite assurance to users of maximum value-for-money.

G.P.4

GENERAL REFRACTORIES LTD.

HEAD OFFICE: GENEFAX HOUSE, SHEFFIELD, 10. TELEPHONE 31113 (6 LINES)

Raw Material Markets

The Control of Iron and Steel (No. 15) Order, 1941, Direction No. 2, which has been issued by the Ministry of Supply, extends until September 30 the period during which orders for all iron products except pig-iron, but including castings, may be fulfilled without being authorised by the responsible Government department, subject to certain conditions. All iron products except pig-iron will be incorporated in the steel distribution scheme. Priority consumers' iron and steel requirements are being met in full. Heavy engineers are still briskly engaged on war contracts, but business in light castings is at a low ebb. Makers of the latter are well supplied with high-phosphorus iron, which is obtained from home-produced ores, and in many cases stocks have been accumulated. Low-phosphorus iron and hematite, however, are still in short supply.

Pig-Iron

MIDDLESBROUGH—Local foundrymen are able to acquire adequate supplies of iron from the Midlands, which has been the source of supply since furnaces on the North-East Coast were transferred to the manufacture of iron for the steelworks. The output of Cleveland foundry iron is nowadays unworthy of consideration, as it represents a negligible contribution to the aggregate needs of consumers. Business among the heavy founders continues to be very active, but there is little change in the dull conditions which have prevailed for so long in the light-castings section.

There has been a slowing down of late in the demand for East Coast hematite, but this is expected to be no more than a temporary decline, due to holidays and also the gratifying results which many buyers have obtained as a result of incorporating other grades of iron in their mixtures as a measure of economy. Stocks of hematite are practically non-existent, so that the full output continues to be needed for urgent business and there is no material available for distribution to non-priority consumers.

LANCASHIRE—In the aggregate the demand for foundry iron in this area is no more than moderate, as the call for supplies from the light-castings and jobbing foundries is at a low ebb, while textile machinists are also quietly employed. Heavy engineers, on the other hand, are able to operate at a brisk rate, as plenty of work of national importance is available for their products. Ironfounders are keen to purchase pig-iron ahead and the Control permit business to be negotiated for deliveries up to the end of the year.

MIDLANDS—Makers of heavy iron castings are fully employed on orders from Government departments, but the position in the light-castings section shows no indication of any change for the better. Both low-phosphorus iron and hematite, which are required by the heavy engineers, are in short supply, but a considerable amount of success is being obtained from the utilisation of high-phosphorus and refined irons, together with steel scrap, in furnace mixtures, the better quality irons being reserved exclusively for users who cannot easily do without supplies. With the building trade poorly situated, there is little activity in light castings and many foundries are operating on short time. Ample supplies of high-phosphorus iron are being delivered and many works have stocks on hand.

SCOTLAND—Maximum tonnages of foundry iron are being taken up by the heavy engineering trade and there is little or no surplus after all requirements have been satisfied. Government orders play a very important part in the operations of the heavy-castings branch, so that every effort has to be made to ensure that adequate tonnages of iron are available to prevent loss of time. Foundry iron for the makers of light castings in Scotland is purchased in the English Midlands, as the output of Cleveland material is still virtually suspended. Despite the longer haulage entailed, however, the volume of iron forthcoming is quite sufficient to cope with all demands. Actually, consumption of iron in the light-castings branch is anything but impressive, as only a few works are really well employed and several are on short time. There is little in the way of Government work available for this section and the scope of ordinary business has been considerably curtailed by wartime conditions.

Coke

There is a regular flow of deliveries of foundry coke, and the ovens are dealing very satisfactorily with the demand for fuel for stocking purposes, with the result that many consumers will be well placed before the winter comes, so that any tendency for supplies to be delayed will not cause immediate inconvenience. A minimum price of 62s. 9d. per ton is still invoiced for deliveries to stations in the Birmingham and Black Country districts.

Steel

Steel output has been still more closely regimented to the needs of the war machine in recent weeks, and the revised structure of the industry is resulting in certain sections being more quietly employed. Civilian consumption has been narrowed appreciably, and every possible means has been taken to economise in the use of steel, so that the maximum tonnage may be placed at the disposal of the various Government departments. Carbon steel is now less active, but there has been a big expansion in the call for alloy steels, which are widely used for the production of munitions, etc. Changes in the technical processes of steel manufacture have been made imperative, and it is satisfactory to report that deliveries to the war factories are quite sufficient for current needs.

Scrap

Generally speaking, consumers of scrap iron and steel are receiving satisfactory deliveries, and a certain amount of stocking is being carried out. While the delivery position is considerably easier, there is certainly no glut of scrap, and no opportunity for procuring fresh supplies can be missed. As a matter of fact, imports of old metal are still being made, although every effort continues to be exerted with a view to attaining a position whereby the need for bringing in scrap from abroad is eliminated. Material suitable for the steel furnaces continues to be in greatest demand, but there has been a slightly quieter tendency in this section of late.

Metals

COPPER—Satisfactory reports continue to be forthcoming regarding the supply of copper to essential consumers, and in some instances it has been possible to accumulate reserve stocks. Non-priority users are still not receiving more than a small proportion of their requirements; nor is there much likelihood of additional supplies becoming available for ordinary domestic needs, as the Control authorities are endeavouring to guard against any possible interruption in arrivals of the metal in the future.

TIN—Turnover in tin on the London Metal Exchange has remained only moderate, with prices steady. Restricted trading is, of course, inevitable, in view of the continued suspension of export licences. There has been a tendency of late for tin consumers in the United States to apply to the Metals Reserve Company for spot metal; the reason for this would seem to be that a number of users have not increased their own reserves materially since the establishment of the Government stock. At the same time, many large tin consumers in America have not changed their policy of buying metal in excess of their early requirements, and considerable tonnages are held by some purchasers. No details of the amount of tin released by the Metals Reserve Company are now divulged, so that the statistical position remains obscure. According to the American Bureau of Metal Statistics, total consumption of tin in the first five months of the year was 38,920 short tons, the principal consuming industries being as follow: Tinplate, 18,200 tons; solder and babbitt, 10,300; bronze tubes and foil, 5,620. Deliveries (including re-exports) in the same period were 65,492 tons.

World production of tin in July, according to the Statistical Bulletin of the Tin Research Institute, is estimated at 18,100 tons, compared with 19,900 tons in July, 1940. Production for the first seven months was 147,900 tons, against 125,100 tons in 1940. United States deliveries totalled 12,575 tons in July, against 14,880 tons in June. U.S. deliveries in the first seven months of 1941 were 92,947 tons, compared with 57,934 tons in the corresponding period of 1940. Tin consumption of the United Kingdom was 2,426 tons in June, 1941, against 2,501 tons in May and 2,784 tons in June, 1940. World stocks of tin, including smelters' stocks and carry-over, increased by 327 tons during July last to 56,302 tons at the end of the month. Stocks at the end of July, 1940, were 48,830 tons.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £256 15s. to £257 5s.; Friday, £257 5s. to £257 10s.; Monday, £256 15s. to £257 5s.; Tuesday, £256 5s. to £256 10s.; Wednesday, £256 5s. to £256 10s.

Three Months—Thursday, £259 15s. to £260; Friday, £259 15s. to £260; Monday, £259 5s. to £259 10s.; Tuesday, £259 5s. to £259 10s.; Wednesday, £259 5s. to £259 15s.

SPELTER—While there is still little spelter released to non-essential consumers, the supply position appears to have shown some improvement recently. Consumption on account of war production is maintained at a very substantial rate, but plenty of metal is being delivered for important contracts. Some business is being transacted with Indian buyers of yellow metal, licences being granted for this purpose.

LEAD—In wartime the consumption of lead tends to fall below peacetime levels; this was noticeable in the 1914-18 conflict, when consumption fell from 230,000 metric tons in 1914 to 159,000 tons in 1917. In 1918 a recovery to 223,000 tons was attributable to the extravagant use of the metal in ammunition in the final stages of the hostilities. Although no statistics are available, it is certain that the present war has brought about an appreciable lessening in the use of lead, due in the main to the quietness of the building trade, and particularly in the house-building section, and ample supplies are on hand to cope with requirements apart from the various war needs. Even so, the Control authorities are scrutinising carefully all applications for deliveries, and fresh purchases can only be made subject to licences being obtained.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

534,304 DARWINS, LIMITED. High-speed tool steel.

534,352 ASHMORE, BENSON, PEASE, & COMPANY, LIMITED, and BROWN, W. R. Moulds for casting pigs, and pigs cast therefrom.

534,422 LANGLEY ALLOYS, LIMITED, and SKRIPT, G. Pattern plates for the production of sand castings.

534,435 BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Apparatus for enamelling wires.

534,436 RANDALL, J. E. Coating of metals with tin.

534,570 ABBEY, A. (Consolidated Mining & Smelting Company of Canada, Limited). Iron alloys containing manganese.

534,624 SOC. ANON. DES HAUTS-FOURNEAUX ET FONDERIES DE PONT-A-MOUSSON. Piping elements and process and outfit for manufacturing same.

534,636 LINDEMUTH, L. B. Metallurgical furnaces.

534,658 GARBISCH, N. S. Method and apparatus for removing magnetic impurities from finely-divided materials.

534,663 STANTON IRONWORKS COMPANY, LIMITED, WILSON, P. H., and DAWSON, S. E. Casting of metals.

534,671 STEVENS, A. H. (Eaton Manufacturing Company). Non-oxidising heat-resisting alloy steels, and articles made therefrom.

534,739 SCHNEIDER & CIE. Moulds for casting ingots.

534,756 WILLIAMS, E. R. Method and apparatus for casting metals.